



**OREGON STATE UNIVERSITY**

**OREGON AGRICULTURAL EXPERIMENT STATION**

# Plan of Work

## Annual Report of Accomplishments and Results

Oregon Agricultural Experiment Station  
Oregon State University

Federal Fiscal Year 2002

A handwritten signature in black ink that reads "Thayne R. Dutson".

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## A. Planned Programs

### Goal 1:

#### **An agricultural system that is highly competitive in the global economy.**

Through research and education, empower the agricultural system with knowledge that will improve the competitiveness in domestic production, processing, and marketing.

### OVERVIEW

#### OUTPUTS:

Research results have been shared through refereed journal articles, abstracts, books and book chapters; theses, local, regional, national and international meetings, symposia and workshops; GIS climate, geophysical and plant maps; and web pages of an array of types.

- Published 107 refereed journal articles, 27 proceedings papers, 101 abstracts, and 23 theses.
- Made 64 presentations at national, international, and professional meetings.
- Organized 3 workshops.

#### OUTCOMES:

- Enhanced value of eggs to the consumer by adding CLA to layer diets. Easily measurable plasma indicator for cystic ovaries in dairy cows that should help producers identify and eliminate these cows from their herds. Identified that sperm from low mobility males have poor straight line mobility. This indicator has helped the industry to eliminate these potentially low fertility males. Discovered factors that influence feed intake and developed nutritional strategies to minimize pre-partum feed intake depression. Basic research with MARCKS enzyme provides new information about the underlying basis for regression of the corpus luteum in cattle. Established direct proof that COUP-TF is responsible for the negative control of fat cell differentiation. Generated evidence that insulin resistance or gestational diabetes in Holstein cows may be the culprit behind the dramatic decline in feed intake prior to parturition.
- Analytical results indicate that the most important factor in biotechnological advancement is university bioscience research; analysis shows that increased industry concentration leads to increased research and development expenditures and ultimately faster productivity growth; analysis indicates that food processors make extensive use of foreign direct investment to gain access to foreign markets and the implication of this investment on employment in the U.S. food sector.
- Research has improved our understanding of plant growth and development and the mechanisms of several diseases. For example, proteins required for suppression of plant defenses to viral infections were identified, genes involved in susceptibility to viruses were characterized, the genome sequence of a bacterial pathogen was determined, and fungal

pathogenicity factors were further characterized. The importance of plot size to the spread of disease epidemics was revealed, biological control of fire blight was enhanced.

- A group of OSU scientists has worked extensively with their scientific counterparts in China along with Oregon seed industry representatives to develop a testing program for turf grasses in China. This project began ten years ago and continues today. GIS technologies are now being employed to tie climate, geophysical and plant adaptation information to allow scientists to predict adaptation zones for grass species across China and Southeast Asia. Understanding of the oil synthesis pathway in meadowfoam has allowed the development of germplasm with low erucic acid. Advanced generation lines are near release and will allow entry of meadowfoam oil into edible, medical and nutraceutical markets. New fresh market (red skinned Modoc and Mazama) and chipping potato (Willamette) cultivars were released. These cultivars will meet the growing demand for gourmet and niche market use potatoes and allow some growers to step away from total dependency on processing markets. The new soft white winter wheat cultivar Tubbs was released. Over 37,000 pounds of foundation seed was produced and sold in 2002.
- Developed new analytical methods and extraction procedures to measure the chemical composition of tannin constituents in grapes and wine, and bitterness perception of iso-alpha acid homologues from hop components in beer. Development of physical and physiochemical measurements, film coatings and packaging technologies to improve fruit keeping quality and nutrient retention. Developed novel delivery systems to add vitamin and mineral nutrients to surface coatings of fruits and vegetables.
- The binding of proteins to DNA and the folding-unfolding kinetics of proteins have been elucidated by new mass spectrometry based methodologies. Prenylflavonoids, which have potent anticancer properties, have been extracted from hops and characterized by mass spectrometry. A unique gas-chromatography electron-monochromator time-of-flight mass spectrometer has been built based on a novel design that allows exceptionally high data acquisition rates.
- Developed edible coatings were applied on fresh and frozen strawberries and raspberries, and showed significant improvement on the storability and quality of the product. Vacuum impregnation technology also demonstrated its significant potential for extending shelf-life and improving final product quality of fresh-cut, frozen and dehydrated high porosity fruits, such as apple, pears, and strawberries. In addition, both technologies demonstrated their capability to be used as an alternative method for developing nutritionally-fortified fruit and vegetable products
- Researchers have identified molecular markers for single gene resistance to EFB. These markers decrease the time needed to select resistant individuals in segregating populations from 18 months to days. In addition, non-resistant plants are not planted in the field for further evaluation thus increasing the efficiency of planting and decreasing the costs of growing progeny from new crosses. Other researchers have greatly improved the efficiency of micropropagation of difficult to propagate clones by the use of a double-phase-medium and hormones.

- Recent results have shown the superior efficacy of DNA based vaccines for immunization of fish. Baculovirus-vectored foreign genes have been expressed in fish. Gene silencing of oncogenes has produced Crown Gall resistant apple plants. Recent studies have indicated that fish may be a reservoir for bacteria that are potential pathogens of humans.

#### IMPACTS:

- Identification of the straight line velocity of sperm will help the poultry industry to eliminate potentially low fertility males. Discovery of factors that influence feed intake and development of nutritional strategies that minimize pre-partum feed intake depression has the potential for alleviating the most significant metabolic disorder in dairy cattle. Basic research with MARCKS enzyme provides new information about the underlying basis for regression of the corpus luteum in cattle.
- The impacts of this work accrue at three levels. First, much of the basic methodological research has been adopted by other researchers. Second, this research has helped policy makers understand the rationale for and benefits of public investment in agricultural research. Third, university policy makers can potentially use much of this research to help justify public investment in agricultural research and to design more effective policies relating to patents and intellectual property rights.
- Work on biological control, nematocide trials, disease epidemiology will have immediate impacts on agricultural in Oregon and elsewhere. Work on the basic mechanisms of viral, bacterial and fungal diseases is laying the foundation for future strategies to combat diseases. Projects directed towards understanding mechanisms of plant growth and development are enhancing the knowledge base necessary to make improvements in yield, nutritional value, disease resistance, and other desirable properties of plants.
- Instrumentation and methods developed in this program are central to characterizing protein structure and function (proteomics). Understanding of proteomics is a key in the ultimate success of many aspects of biotechnology. Ion optics developed as part of this program have been incorporated in a commercial instrument that promises to have a major impact on progress in proteomics. The identification and characterization of flavonoid compounds has contributed to a better understanding of the potential beneficial health effects of food products containing these compounds. These compounds are found in hops and are present in beer. They are potent antioxidants and effectively trap free radicals that can cause cancer.
- Grass seed sales to China have increased from less than 340,000 pounds in 1994-95 to over 10 million pounds in 2002 with an estimated value of over \$6.5 million dollars. Sales increased by over 3 million pounds (\$1.95 million) in 2002 alone. With the 2008 Olympics to be held in China, it is anticipated that turf grass sales will increase significantly over the next several years. At the same time, the GIS adaptation work that is a part the project with China is being embraced as a means to address desertification concerns across Southeast Asia. Identification and planting of adapted grass seed species will improve land stabilization and forage performance. This work could have impacts on worldwide air quality. On average, fresh market potatoes have a value 20% higher than their processing counterparts. If specialty potato production increases to 5% of total Oregon acreage, growers

could realize an increase in annual income in excess of \$1 million. Tubbs wheat has a yield potential 5 to 7% higher than that of currently grown cultivars and a similar adaptation range. At a 5% increased yield, the 2005 commercial crop that could to be harvested from the current year seed stock will have a single year increased value in excess of \$300,000. Over time, this cultivar could increase wheat gross income by over \$2 million annually.

- The project has provided plant breeders, food processors and nutritionists with information that should have positive impacts on value-added products and human health. The information on the physicochemical properties of fruits and vegetables will help selection in fruit and vegetable breeding. Our edible coating technology has received great interest from processors and the general public due to its great potential for extending shelf-life of fresh berries and enhancing their nutritional value. Information on yeast fermentation, wine tannins, and hop flavors related to brewing extraction and processing will be used by Pacific Northwest wineries and breweries.
- The results from the research include the release of two varieties “Lewis’ and “Clark” with good general resistance to eastern filbert blights. In addition, these two varieties have improved kernel quality, which will help the Oregon industry to be even more effective on the world market. Resistant pollinators also have been released. These varieties are being widely planted in Oregon and their adoption has resulted in the acreage planted to hazelnut remaining constant at 30,000 acres.
- We have developed methods to express foreign genes for producing vaccines directed at microorganisms ranging from strep throat in humans to viruses of economically important fish species. One of our PIs has shown that the heretofore uncontrollable disease, crown gall, can be controlled with the cell silencing approach, and the strategy might be extended to other fruit, nut, and cane berries.

#### ASSESSMENT:

All units in the Oregon Agricultural Experiment Station are required to conduct annual performance evaluation of their faculty members. These annual reviews are conducted based on goals established during previous year’s reviews. Since all faculty members with OAES FTE are required to establish their station projects, annual performance evaluation serves a good vehicle to assess our progress toward the goals in our plan of work. OAES has made good progress in meeting these goals.

TOTAL EXPENDITURES: \$23,954,360

Hatch- \$1,320,991

State- \$22,053,385

Multistate- \$579,984

TOTAL FTE: 90.45

ACCOUNTABILITY:



Additional information regarding research programs conducted through the Oregon Agricultural Experiment Station may be found in “*Oregon Invests*”, a research accountability database accessible on the web at:

<http://oregoninvests.css.orst.edu>

There are currently over 388 reports contained in the database, searchable by selected criteria. Each report undergoes systematic professional review with analysis of projected economic, environmental and social effects, as appropriate.

Examples of search topics for Goal 1: disease resistance, pest management, genetics, irrigation, plant pathogens, genomes, biotechnology, sperm mobility, seafood processing, wheat cultivars, and pollination management.

## Key Theme: **Agricultural Competitiveness**

### *ISSUE OR PROBLEM*

As assessed by the Department of **Agricultural and Resource Economics**, the genetic engineering made possible by the discovery of recombinant DNA has played an increasingly important role in agricultural research. This rapid expansion has led to questions about the optimal mix of basic and applied research in agricultural biotechnology and the relationships between public and private research.

Like many U.S. fisheries, the Pacific whiting fishery has been managed based on biological models. To demonstrate the potential for comprehensive economic-based approaches, the **Coastal Oregon Marine Experiment Station** developed a bioeconomic management model that integrated economics, product quality, and biology. The model results demonstrated that whiting should be harvested later in the season in order to maximize economic and biological objectives.

Dairy farming in the U.S. is under pressure by the decline of milk prices and environmental concern for dairy farm nutrient losses. A world market price for milk is causing larger dairy farms to be concentrated in certain geographic locations. The cost of managing manure nutrients is being assumed by the farm owner. Integrated research and technology transfer programs are being developed in the Department of **Crop and Soil Science** to discover how to better help dairy farmers manage their farms in a cost effective and environmentally acceptable manner that complies with newly imposed farming regulations.

### *IMPACT*

Research conducted by the Department of **Agricultural and Resource Economics** constitutes the first econometric analysis of the detailed information flows between university bioscience and agricultural biotechnology. It therefore allows, as no other study has done, an examination of the manner in which science and technology expenditures can best be allocated, and scientific personnel best be trained and deployed, in the U.S. agricultural research system. Key results indicate: that university bioscience research and graduate education are complementary; that lower ranked universities are more efficient than highly ranked universities in producing graduate students and cited bioscience research; that resources should be reallocated from non-post-doctoral inputs to post-doctoral fellows; that resources should be

reallocated from biology programs toward agricultural programs; and that basic bioscience and applied biotechnology research are complements in the production of agricultural biotechnology innovations.

Research conducted at the **Coastal Oregon Marine Experiment Station** continues to be used by the Pacific Fisheries Management Council to set seasons to generate optimal harvests, quality, and market price. It is estimated that a two month later opening season in 2002 generated over \$500,000 in profits to the industry and additional income of \$1,500,000 to coastal communities.

All dairy farm systems that utilize pasture can benefit from research conducted in the Department of **Crop and Soil Science**. Dairy farms are complicated systems and most operations can more carefully establish and manage their species. Using the best maps for climate, soil, and plant information will help to optimize decision making for agricultural systems management. By integrating individual spatial data layers for climate, geophysical factors, and plant characteristics in a GIS program, it is possible to better understand their interrelationships and respond accordingly. Future objectives include linking these GIS based maps with grass simulation models for predicting seasonal production profiles of the various species. Extension circulars for four grass species have been prepared with colleagues from around the US. Web sites are being created. Extension circulars provide information on establishment, management, and utilization, including management of manure and other nutrients in the production of these forages.

*SCOPE OF IMPACT* - State, national, and international

*SOURCE OF FUNDING* - Hatch, State funds, Smith-Lever, Specific Cooperative Agreement between Oregon State University and U.S.D.A.-Agricultural Research Service, Commodity funds, OSU Foundation

## Key Theme: **Agricultural Profitability**

### *ISSUE OR PROBLEM*

The Department of **Bioengineering** is working on a project that will assist resource managers and stakeholders in understanding processes in a range of ecological systems, and allow incorporation of scientific understanding into management and stakeholder decision-making.

The Molluscan Broodstock Program at the **Coastal Oregon Marine Experiment Station** will improve meat yields of commercially farmed pacific oysters through the application of modern molecular genetics, classical selective breeding, and effective outreach to industry.

The Department of **Crop and Soil Science** is working on the development of new types of wheat for Oregon farmers that are better suited for producing specific flour products such as noodles, Chinese steamed breads, and bread by understanding the chemistry of the grain.

The Department of **Food Science and Technology** is working on the development of new types of wheat for Oregon farmers. The new wheat types will be better suited for producing specific flour products such as noodles, Chinese steamed breads, and bread by understanding the chemistry of the grain.

Weeds continue to be one of the major production issues in horticultural row-crops. A combination of control measures are needed. New herbicides need to be tested for use in these crops. At the same time, production practices that reduce weed populations need to be implemented. A project conducted by the Department of **Horticulture** will evaluate new herbicides for use in horticultural row-crops. The project will study tillage rotations in those crops and study the biology of two weeds that cause losses in those crops.

Small local farmers are in need of apple varieties suitable for fresh market production. The Department of **Horticulture** is conducting additional research to identify apple varieties that meet the criteria for small farmers in Oregon.

A partnership of family farmers, agency representatives, and university faculty in the Department of **Horticulture** will research and develop farming practices that enhance water quality and maintain or improve profitability of family farms. Reduced tillage and integrated pest management practices will be integrated to reduce possible pesticide runoff and extended both in Extension and the classroom.

An evaluation from the **Mid-Columbia Agricultural Research and Extension Center** concluded that the Mid-Columbia sweet cherry industry is undergoing a radical transformation in orchard production methods involving the use of recently available self-fertile cultivars, dwarfing rootstocks and new tree training methods. The new emphasis is to produce fruit for the fresh market. We aim at developing production systems that will optimize high-quality fruit yields for maximum economic returns.

#### *IMPACT*

The Department of **Bioengineering** has worked to develop and distribute the POND software, which is used for assisting aquacultural producers in more effective production facilities. POND continues to be used worldwide, with over 5000 users having downloaded the software from our website. They continue to build strong relationships with community watershed stakeholder groups regarding scientific restoration decision-making. Products from their simulation tools work are being adopted by a number of international groups. An additional decision support tool for watershed restoration decision support has been developed and is being used by a number of watershed groups for restoration planning and prioritization. This tool, RESTORE, allows consideration of a variety of ecological, hydrologic, social and economic factors to identify high-priority sites for restoration. It uses a geographic information system-based spatial data manipulation engine, coupled with a rule-based multiobjective decision-making algorithm to examine entire watersheds for possible restoration sites taking into account stakeholder-defined goals and objectives, generating maps of where particular strategies are particularly appropriate.

As a result of the research conducted at the **Coastal Oregon Marine Experiment Station**, several commercial oyster hatcheries are using Molluscan Broodstock Program broodstock to produce large numbers (millions) of spat for the West Coast industry and foreign markets. If a 9.5 percent improvement in yield was obtained for all oysters planted by the West Coast oyster industry, this would result in an increase in production valued at \$6.5 million, assuming that the total annual harvest is valued at \$68 million.

Research conducted by the Department of **Crop and Soil Science** has made progress toward increasing the speed and effectiveness of the wheat breeding program by providing a new selection tool for selecting wheat types with desired combinations of key proteins associated with good breadmaking. This is a first step in the move towards generating a suite of more

effective quality selection tools for the breeding program. The objective is to get new desired varieties into the hands of Oregon wheat growers more rapidly in order to enhance the growers' long term economic viability.

Research performed by the Department of **Food Science and Technology** has made progress toward increasing the speed and effectiveness of the wheat-breeding program. This progress has been made by providing a new selection tool for selecting wheat types with desired combinations of key proteins associated with good bread making. This is a first step towards generating a suite of more effective quality selection tools for the breeding program. The objective is to get new varieties that are desired by our end-user customers into the hands of Oregon wheat growers more rapidly than is presently possible in order to enhance the growers' long-term economic viability.

The Department of **Horticulture** expects that the results of their study will help growers make informed decisions about weed management strategies for weeds in row crops.

As analyzed by the Department of **Horticulture**, the cooler, wet growing season in western Oregon and Washington delays time of ripening, may influence fruit quality, and increases the incidence of fungal diseases such as scab, mildew, and anthracnose. Newer cultivars that are suitable in these growing conditions are being identified from results obtained in these two trials. Distribution of the fruit for tasting was coordinated with the Linn and Benton County Master Gardener Program. Fruit from the 1995 trial was displayed and offered for tasting three times in the fall of 2002 at the local farmer's market. An informal tally of consumer preferences was taken and 'Arlet' and 'Honeycrisp' were among the favorites.

Research conducted by the Department of **Horticulture**, a partnership of family farmers, and agency representatives will provide benefits as follows: improved water quality, reduced soil and pesticide loss, improved or maintained profitability of family farms.

At the **Mid-Columbia Agricultural Research and Extension Center**, research findings on new rootstock and cultivar performance, training systems, chemical bloom thinning for crop load management, and irrigation management are being integrated to develop more profitable cherry orchard production systems. Methods to better manage/conservate irrigation water are expected to increase water use efficiency, improve weed and disease control and help maintain groundwater quality. Based on an 8% discount rate and a 25-year time horizon, research conducted on sweet cherry at the MCAREC has benefited the Mid-Columbia region by \$1,576,740/yr in net cash receipts.

*SCOPE OF IMPACT* - State, national, and international

*SOURCE OF FUNDING* – Hatch, State funds, Commodity groups, Competitive regional grants, Fund for Rural America, Policy Analysis Center for Western Public Lands, OSU Foundation, Agricultural Research Foundation

## Key Theme: **Animal Health**

### *ISSUE OR PROBLEM*

Research conducted by the Department of **Animal Sciences** focuses on the maternal supply of n-3 polyunsaturated fatty acids which can alter the n-3 and n-6 eicosanoid metabolism in the progeny leading to improved cardiac health and reduced mortality in broilers.

The overall goal of one project in the Department of **Microbiology** is to determine the molecular mechanism of tetracycline resistance in *Chlamydia suis* isolates. With the NADC, we have identified and characterized several strains of *Chlamydia suis* that are resistant to tetracycline. Identification of the mechanisms of resistance will allow screening protocols to be developed to investigate the distribution of resistant isolates.

#### *IMPACT*

The Department of **Animal Sciences** has learned that maternal dietary n-3 fatty acids can alter the long-term retention of health enhancing n-3 eicosanoid precursor in the broiler heart tissue. During periods of fast growth, the cardiac tissue may need long chain polyunsaturated fatty acids which are not present in adequate amounts in commercial diets, the lack of which can predispose birds to cardiac abnormalities.

The Department of **Microbiology** anticipates that their work will serve as a model for the analysis of chlamydial acquired antibiotic resistance. They are in a position to easily screen for tetracycline resistance in clinical isolates, which will allow them to determine the range of tetracycline resistance in farm environments. They will also use these studies to put procedures in place to examine and evaluate any tetracycline-resistant chlamydial isolates from humans. Finally, these studies will provide key information on gene acquisition in the chlamydiae, an area of research that is currently uninvestigated.

*SCOPE OF IMPACT* - National and international

*SOURCE OF FUNDING* - Hatch

### Key Theme: **Animal Production Efficiency**

#### *ISSUE OR PROBLEM*

Current methods of estrous synchronization in cattle and sheep are not optimal. Research conducted by the Department of **Animal Sciences** will elucidate the complex functional interrelationships between ovarian production of oxytocin and the role of this hormone in stimulating uterine secretion of prostaglandin F2alpha in ruminant species.

As assessed by the **Eastern Oregon Agricultural Research Center**, annual winter-feed costs in the Intermountain West often total \$150 to \$200 per cow. This represents a major cost to beef producers. Also, the ability of Intermountain beef producers to compete with other regions of the United States depends on how effectively they can reduce winter-feed costs while maintaining acceptable levels of production.

#### *IMPACT*

Results of the research conducted by the Department of **Animal Sciences** provide new information about the underlying basis for regression of the corpus luteum in cattle. The acquired data may be utilized to develop a more effective method of synchronizing estrus in domestic animals.

Work at the **Eastern Oregon Agricultural Research Center** accomplished in fiscal year 2002 demonstrates that infrequent supplementation of non-protein nitrogen is an acceptable means of providing supplemental crude protein to ruminants. In addition, data suggests that forage kochia has potential as a complimentary forage in the Intermountain West. This research has provided information that can be used by Intermountain beef producers to lower annual feed costs and improve economic sustainability.

*SCOPE OF IMPACT* - National, and international

*SOURCE OF FUNDING* – Hatch, State funds

## Key Theme: **Aquaculture**

### *ISSUE OR PROBLEM*

Disease impact both wild and captive fish. One is a bacterial disease called 'fish mycobacteriosis' or 'fish tuberculosis.' Many strains or species of *Mycobacterium* occur in fish, and the Department of **Microbiology** will use both traditional methods and molecular biology to resolve their identity. This project examines the taxonomy of *Mycobacterium* pathogenic bacteria Oregon fish.

The infectious hematopoietic necrosis virus (IHNV) is a serious pathogen of salmonid fish, especially when reared under hatchery conditions. A DNA vaccine that gives effective protection against IHNV when injected into rainbow trout fry has been developed in the Department of **Microbiology**. However, injection vaccination is not practical on a large scale, and a more efficient means of delivery of this vaccine needs to be developed, such as oral or immersion administration. We have found that insect baculoviruses can be exploited for the delivery of genes to cultured fish cells, and thus have potential for the delivery of DNA vaccines to fish in vivo. Our strategy is to determine a set of optimized conditions for baculovirus delivery of genes to fish, and use this knowledge to design baculovirus vectors and vaccination protocols that can be used to protect rainbow trout against IHNV disease.

### *IMPACT*

The genus *Mycobacterium* causes several diseases in animals, including tuberculosis in humans (i.e. *M. tuberculosis*). Particularly with the emergence of AIDS, in recent years many new *Mycobacterium* species have been recognized as virulent or opportunistic human pathogens. Studies by the Department of **Microbiology** has revealed that several other species of *Mycobacterium* can cause disease in fish than what was previously recognized, including human pathogens such as *M. haemophilum*. These results provide further evidence that fish may be reservoirs for *Mycobacterium* infections that are potential pathogens for humans.

Recent studies in the Department of **Microbiology** have demonstrated superior efficacy of DNA based vaccines for immunization of fish compared to more traditional vaccines such as inactivated or attenuated vaccines. However, the practical application of such DNA-based vaccines is limited because they have only been found to be effective when delivered by injection, gene gun, scarification or by the application of short-pulse ultrasound, and not by ingestion or simple bath immersion. We are interested in testing the possibility of using

transducing baculoviruses to deliver DNA modules to fish during immersion, which would be a preferred route of administration in hatchery situations in which large numbers of fry need to be vaccinated. The results of our study indicate that baculovirus vectored foreign genes can be expressed in a variety of fish cell lines, and can be modified to allow increased expression of foreign genes, providing incentive for further investigations on the development of baculovirus-based vaccines for use in fish.

*SCOPE OF IMPACT* - Alaska, Washington and Oregon

*SOURCE OF FUNDING* – Hatch, State funds

## Key Theme: **Biobased Product**

### *ISSUE OR PROBLEM*

All organisms must adapt to environmental change, whether the change is natural or caused by human intervention. Failure to adapt can lead to cell death, disease, or extinction. One purpose of the study in the Department of **Food Science and Technology** is to understand the biology of biofilm formation as an adaptive behavior. Another purpose is to characterize the biofilm itself to learn if it can serve as a model for industrial or medical biofilms that form on food contact surfaces, in pipes, and in human infections.

### *IMPACT*

Microbial biofilms formed on food contact surfaces by human pathogens represent a significant risk to food safety. Biofilms are also a significant problem in chronic human infections. Nonetheless, we know little about the mechanisms involved, and therefore have limited means of preventing such formation. In order to learn about mechanisms of formation, the **Department of Food Science and Technology** is developing a molecular genetic model of a biofilm formed by a wine strain of the experimentally tractable, but non-pathogenic yeast *Saccharomyces cerevisiae*. In an unrelated study, we have developed a prototype yeast strain that uses nitrogen more efficiently than the parent strain and that may lead to benefits for the wine industry.

*SCOPE OF IMPACT* - National and international

*SOURCE OF FUNDING* – Hatch, State funds, National Institutes of Health, The National Science Foundation, Fulbright grant, USDA Special Grant, Commodity groups

## Key Theme: **Biotechnology**

### *ISSUE OR PROBLEM*

Mass spectrometry is an analytical method used to structurally characterize, identify, or quantify chemicals and biological molecules. The Department of **Chemistry** is working to design and develop novel mass spectrometric instrumentation and methods and, through either

collaboration or analytical service, apply them to research in the agricultural, environmental, and toxicological sciences.

As assessed by the Department of **Food Science and Technology**, agriculture and forest-based economies produce tremendous volumes of plant byproducts. These byproducts are rich in carbohydrates, particularly cellulose, that are viable starting materials for the production of a vast array of value-added biochemicals. Large amounts of plant material are not currently used in such processes because, based on available technology, it is cheaper to synthesize comparable petrochemicals. A major thrust is thus underway to improve technologies for the conversion of apparently low-value carbohydrates to high-value industrial biochemicals, including ethanol. Efficient enzyme-based reactors, for example those based on the use of cellulolytic enzymes, are expected to be key operations within such processing schemes. The successful implementation of such processing schemes would reduce our dependence on foreign oil, lower overall greenhouse gas emissions, and strengthen the economies of rural plant-productive regions.

### *IMPACT*

As assessed by the Department of **Chemistry**, innovative function-based approaches to proteomics and novel methods for probing protein-DNA interactions are critical for identifying proteins and for advancing our understanding of protein function. Identification of proteins and elucidation of their functions is a key to progress in environmental health sciences, environmental toxicology, and biotechnology. GC/EM-TOF-MS should be of immediate benefit to agricultural sciences. Many agricultural chemicals should be detectable at levels equal to or below current standards (because of the TOF analyzer) with much greater speed and reliability (because of the TEM.) Methods for characterization of neurofilament proteins aid in assessing the hazard and risk associated with environmental chemicals. Mapping of neuropeptides and H/D exchange analysis contribute to understanding neuropathy at the molecular level. Equilibrium unfolding studies are significant, first, because they provide new data on an enzyme that plays an important role in the immune system and, second, because they lead to the development of new methodology for studying protein dynamics and analyzing the thermodynamics of protein unfolding, which is critical in developing biotechnology. Identification and characterization of flavonoid compounds contribute to a better understanding of potential beneficial health effects of food products that contain these compounds. These compounds are found in hops and are present in beer and, as potent antioxidants, effectively trap free radicals that cause cancer.

Cellulose, the most abundant polymer in the biosphere, is an important biodegradable raw material in the food, feed, paper, construction and textile industries. Novel cellulose-based products, may be developed if economical, bio-based, technologies can be developed for tailoring the chemical and physical properties of this polymer. One approach by the Department of **Food Science and Technology** is to use highly specific cellulolytic enzymes for the selective treatment of cellulose. The affinity ligands discussed in this work provide a means for obtaining such highly specific cellulolytic enzymes. The ability to obtain such defined enzyme preparations also allows for more refined studies to improve enzyme technologies for plant biomass-to-ethanol processes. Biomass-to-ethanol processes typically employ cellulolytic enzymes for the conversion of the cellulose component of plant materials to glucose. The glucose is subsequently fermented to ethanol; the resulting ethanol being a viable liquid transportation fuel.



*SCOPE OF IMPACT* - National and international

*SOURCE OF FUNDING* – Hatch, State funds, National Institutes of Health, The National Science Foundation, Fulbright grant, USDA Special Grant, Commodity groups

## Key Theme: **Niche Market**

### *ISSUE OR PROBLEM*

A continual decline of the production base in textiles and sewn products has resulted in the loss of manufacturing knowledge and jobs, and has impacted the balance of trade. The purpose of a study conducted in the Department of **Health and Human Sciences** is to develop and compile responses to creative strategies for merchandising, producing, and distributing innovative textiles and sewn products.

### *IMPACT*

The impact of the study conducted by the Department of **Health and Human Sciences** will be two-fold. First, the information will result in the development of creative strategies for merchandising, producing and distributing textiles and sewn products. These creative strategies are critical for small manufacturers to compete with larger manufacturers in the global marketplace and for non-urban retailers to compete with corporate retailers, who often pull consumers from rural retail areas to larger shopping centers and thus divert economic development away from rural communities. Second, the data will assist non-urban manufacturers of textiles and sewn products as well as retailers in better meeting consumers' needs and preferences and thus contribute to increased economic development. Effective merchandising strategies of U.S. textiles and sewn products can increase consumer satisfaction, market share and profitability for rural businesses and can enhance choices for rural consumers.

*SCOPE OF IMPACT* – Oregon

*SOURCE OF FUNDING* – Hatch, State funds, Commodity groups

## Key Theme: **Nutrient Mangement**

### *ISSUE OR PROBLEM*

Nitrogen (N) and phosphorus (P) are elements that limit aquatic plant growth in lakes and slow-moving surface water bodies. Elevated nitrogen concentrations in groundwater are also a public health concern. The purpose of one project in the Department of **Crop and Soil Science** is to develop improved scientific procedures for assessing environmental risk associated with agricultural soil and nutrient management practices. Project findings will assist land managers and public agencies in choosing effective management practices to protect surface and groundwater quality.

### *IMPACT*

Soil testing protocols are a critical aspect of the current national effort to reduce P-induced eutrophication of surface water. The Department of **Crop and Soil Science** found a reasonable correlation between agronomic soil test P protocols and more elaborate environmental soil test P protocols. Project results assist land managers, wastewater treatment facilities and regulatory agencies in effective management of biosolids (municipal sewage sludge) to meet environmental protection goals.

*SCOPE OF IMPACT*-National

*SOURCE OF FUNDING*-Hatch, State funds

## Key Theme: **Organic Agriculture**

### *ISSUE OR PROBLEM*

A research project conducted in the Department of **Horticulture** seeks to find management practices that would reduce over-application of nitrogen, improve nutrient cycling, control erosion, and reduce weed pressure in orchard systems. Specifically, this proposal evaluates soil quality/biology and N uptake, utilization, and distribution in a range of alternative orchard floor management systems (AOFMS).

### *IMPACT*

As evaluated by the Department of **Horticulture**, the 'Fuji' trees, which are biennial bearing, had a significantly higher yield in compost-treated plots. The foliage was more vibrant in color and a significantly higher amount of prunings were removed from compost plots, indicating increased vigor. In Hood River, the 'Red Delicious' trees are much younger and yields are still too small to make a statistical comparison. Grower cooperators were interviewed again this year after the growing season. They observed uneven ripening and delay in harvest with compost amendments. Concerns were raised over scion-rooting in the compost and bark mulch amendments.

*SCOPE OF IMPACT* - Local and regional

*SOURCE OF FUNDING* - Hatch, State funds, Commodity groups

## Key Theme: **Plant Genomics**

### *ISSUE OR PROBLEM*

Diseases such as Cephalosporium stripe and the barley yellow dwarf virus can limit wheat production. Incorporation of genetic resistance to disease in cultivars is the most cost-effective method of control. Secondary and tertiary gene pools will be used to introduce

resistance to cultivars or breeding lines, and address concerns of movement of genes from wheat to a weedy relative, jointed goatgrass. Research conducted in the Department of **Crop and Soil Science** will characterize and quantify the level of hybridization and gene movement between these two species under field and experimental conditions.

The Department of **Crop and Soil Science** also conducts research to better understand stripe rust. Stripe rust (caused by *Puccinia striiformis* f.sp. *hordei*) is an important disease of barley in the western United States. Genetic resistance is the most economical and sustainable method for controlling stripe rust and many other plant diseases. Plants have two principal types of disease resistance qualitative and quantitative.

Additional research in the Department of **Crop and Soil Science** is geared towards advancing the development of the meadowfoam oil industry in the US and increasing the economic viability of meadowfoam oil as substitute for petrochemicals in the manufacture of lubricants, plastics, surfactants, and other industrial products by genetically enhancing meadowfoam, an industrial oilseed crop.

Hazelnut is well-adapted to the Willamette Valley, but current leading cultivars have noticeable weaknesses including susceptibility to eastern filbert blight and poor suitability to the blanched kernel market. The purpose of a project conducted by the Department of **Horticulture** is to develop new hazelnut cultivars and improve our understanding of hazelnut genetics.

The Department of **Horticulture** also conducts studies on white mold and white seeded beans. White mold is one of the most severe fungal diseases of dry and snap beans in the U.S. White seeded beans are not as tolerant of germination in cold wet soils as colored seeded beans. They also have different canning and nutritional qualities. Transferring white mold resistance to common bean will reduce economic losses from this disease. Also, Bean lines that are the same genetically except for seed coat color will help us better understand the relationship between pigments and varietal performance.

Cytokinins are plant hormones which mediate cell division and growth. In order for normal development to occur, the level of this group of hormones must be precisely regulated. Biosynthesis, metabolism and perception are the possible routes of regulation. However, the mechanism of such control is not well understood in plants. Research conducted in the Department of **Horticulture** centers on isolating genes and enzymes controlling the metabolism of zeatin, a naturally occurring cytokinin, in legumes and cereals. The long-term goal is to understand how active and inactive forms of zeatin affect growth and development. During the grant period, emphasis will be directed at cis-zeatin. As cytokinin is known to affect seed/fruit development and grain filling, new genes and enzymes affecting zeatin levels will be useful to improve yield and adaptation of crops.

### *IMPACT*

Our studies on the wheat genetic diversity and the use of alien sources of genetic variation in the Department of **Crop and Soil Science** will allow better management of wheat genetic resources, and the development of wheat lines with improved disease resistance and grain protein content. With the advent of herbicide-resistant wheats, there is a concern about the potential for sexual transfer of genes for resistance into jointed goatgrass, a weedy relative. Our studies on hybridization dynamics between wheat and jointed goatgrass will permit an assessment of the likelihood of gene transfer and the development of the appropriate management protocol to limit gene movement.

Research conducted by the Department of **Crop and Soil Science** will help plant breeders and pathologists to efficiently develop durably disease resistant crop varieties. Fungicides are a useful side arm in the battle against plant diseases, but the best defense is genetics. However, not all of the big guns of genetic resistance are equally effective. Long-term performance is what counts in the plant disease wars. Plant disease resistance can be classified as qualitative or quantitative. Qualitative resistance leads to no disease symptoms and a false sense of security. The evolution of virulence in the pathogen population will almost certainly overcome whatever qualitative resistance is deployed. Quantitative resistance, on the other hand, can lead to a lasting peace. Quantitative resistance is more complicated to achieve, due to complex inheritance, but it is more durable. We are waging our battle against plant disease in terms of a very specific problem on a specific crop: barley stripe rust on barley. Barley growers, processors, and consumers will benefit from the development of varieties with quantitative resistance to stripe rust. In this research, we will determine how many genes determine quantitative resistance, and how they do it. At the end of the day, we want to neutralize barley stripe rust as a production threat. When stripe rust is contained, breeders can turn their attention to making better barley varieties (BBVs) with unique quality and adaptation profiles. These BBVs will have immediate consumer impact and directly contribute to a stronger, healthier, and vigorous society.

Genetically superior cultivars developed via research conducted by the Department of **Crop and Soil Science** has increased seed yields and profits to growers, producers, processors, and end-users. While non-molecular breeding has thus far played a dominant role in the development of new meadowfoam cultivars, our research produced the tools and infrastructure needed for using molecular markers to accelerate the development of genetically superior cultivars. Such tools opened the way to using the molecular genetic linkage map of meadowfoam to locate and study genes underlying economically important traits. The development of low erucic acid germplasm and cultivars could create the basis for the entry of meadowfoam oil into edible, medical, and nutraceutical markets.

'Lewis' and 'Clark', recently released by the OSU hazelnut breeding program, are now the most widely planted cultivars in Oregon. The quantitative resistance of these two cultivars allows hazelnuts to be planted where eastern filbert blight is present, and acreage in the Willamette Valley has remained constant at nearly 30,000 acres. The kernel quality of 'Lewis' and 'Clark' will allow Oregon to compete more effectively on the world kernel market. Our understanding of hazelnut genetics continues to improve, as quantitative traits, Mendelian traits, and molecular markers are studied. RAPD markers are now used in marker-assisted selection for eastern filbert blight resistance. Several new sources of resistance have been identified and used as parents in breeding by the Department of **Horticulture**. Growers are optimistic that completely resistant cultivars will be released in the near future.

As evaluated by the Department of **Horticulture**, the transfer of white mold resistance from scarlet runner bean to green and dry beans will help obviate effects of disease on these crops in the United States. Currently, if a snap bean lot brought to the cannery has more than 2% molded pods, it will be rejected, resulting in loss of revenue to the grower. In Oregon, resistance may increase the average State green bean yields by about a ton per acre, with an increase of farm gate value of about \$3.5 million.

The findings on cytokinins in the Department of **Horticulture** indicate there are trans- and cis-specific enzymes and pathways in regulating cytokinin metabolism. The significance of this research is the relative importance of the types of cytokinins, either trans or cis zeatin is crop

dependent, and therefore, different cytokinin genes should be targeted to manipulate development and economic yield.

*SCOPE OF IMPACT* - National and international

*SOURCE OF FUNDING* – Hatch, State funds, National Institutes of Health, The National Science Foundation, Fulbright grant, USDA Special Grant, Competitive national and regional grants, and Commodity groups

## Key Theme: **Plant Germplasm**

### *ISSUE OR PROBLEM*

The **Central Oregon Agricultural Research Center** is part of a cooperative program to develop new potato varieties for the Pacific Northwest potato industry. New varieties are needed to overcome quality problems and the need to capture new markets.

Plants are very diverse and contain many useful and often unknown genes. In the project's accumulated experience, these are most readily found by biophysical means. Research conducted by the Department of **Horticulture** will characterize and identify plants suitable as to provide genes for crop plants.

Head smut is an important disease of sweet corn grown in the Pacific Northwest. The Department of **Horticulture** provides a head smut screening nursery for sweet corn breeding programs to evaluate their materials. Root rot of sweet corn in western Oregon is causing increasing economic damage, and has caused >50% yield losses. We screen commercial hybrids for. This research identifies for growers and vegetable processors, sweet corn hybrids that are better able to withstand diseases that occur in the Pacific Northwest.

Additional research conducted in the Department of **Horticulture** will find unique and unexplored genes that promote agricultural productivity. We need to expand our knowledge of the myriad known and undiscovered plant genes of use in agriculture.

### *IMPACT*

New potato varieties produced by the **Central Oregon Agricultural Research Center** and cooperative entities will be released with improved yield, grade, pest resistance and culinary quality.

Basic biophysics of germplasm holds many surprises. The Department of **Horticulture** is developing a method to determine chloroplast division in vivo, which has promises of a more sensitive and more immediate measures of crop productivity. Plant breeders have long taken an empiric approach to crop improvement. Our work on CAM evolution suggests that this is based upon cryptic codes commonly unexpressed and unused in the genome.

For head smut resistance, the G and J series RILs should allow the Department of **Horticulture** to map one or more genes for resistance to head smut. Markers can then be identified that are associated with resistance to aid breeding programs in the development of resistant inbreds. Sweet corn is a 'keystone' crop for vegetable production in western Oregon because of its acreage and use in rotations. If its production were to decline, we would likely see a decline in all vegetable production in the Willamette Valley. Low yields caused by sweet corn

decline have made sweet corn production unprofitable for growers and have reduced the quality of ears coming into the processing plants. Root rot trials are identifying new hybrids with tolerance that will replace Jubilee in western Oregon. We could potentially see an increase in sweet corn yields of one to two tons per acre, resulting in an additional farm gate value of \$2.5-5 million.

Chloroplast division as opposed to chloroplast count measured crudely by chlorophyll content is a much more active measure of plant and crop function. The Department of **Horticulture** hopes that their method will become used as a significant indicator of crop production. In general, benefit is expected for all those involved in plant production since it should measure immediate effects of plant inputs, weather, etc. CAM evolutionary theory may have surprising implications with respect to the plasticity of germplasm and suggest unsuspected useful properties of present day crops.

*SCOPE OF IMPACT* - Regional and international

*SOURCE OF FUNDING* – Hatch, State funds, USDA CSREES, Commodity groups

## Key Theme: **Plant Health**

### *ISSUE OR PROBLEM*

For practical reasons, most field research in plant pathology is done in small experimental plots. However, epidemics can often expand over much larger areas in commercial agriculture. In the department of **Botany and Plant Pathology**, the role of plot size on epidemic speed is under investigation in order to develop more accurate models of the factors relating to epidemic speed.

White rot disease, a fungus which permanently infests field soil, threatens to eliminate both garlic seed and onion seed production within the central Oregon region within 10 years as it becomes more widespread. This situation is repeated in other areas of Oregon, the Western U.S. and the world. The focus of one particular project at the **Central Oregon Agricultural Research Center** is to learn how to control and/or eliminate white rot disease on Allium crops, such that infested fields may be replanted to Allium crops without fear of uneconomical losses.

The carrot seed crop and harvested seed from central Oregon is abundantly contaminated by the bacterial blight pathogen; such seed-borne bacteria are a potential source of epidemics of bacterial blight in commercial fields. The **Central Oregon Agricultural Research Center** conducting research to have a better understanding, control and better management of several diseases which threaten both carrot seed quality and continued carrot seed production, which also have regional or even national and international implications.

The industry experiences substantially higher harvesting and subsequent cleaning cost, over \$200 per acre, when ergot sclerotia are present in Kentucky bluegrass grown for seed. The **Central Oregon Agricultural Research Center** conducts research designed to evaluate various control products, the effect of sclerotia in seed at planting and subsequent development on plants, cultural and climatic factors, and determines the efficacy of residue management systems to remove sclerotia from fields.

Research conducted by the Department of **Horticulture** aims to improve the resistance of tomato to *B. cinerea*, the causal agent of gray mold, which is a common problem in hundreds of crop species that has not been resolved.

Crown gall is a problem worldwide and causes millions of dollars of damage each year in fruit and nut orchards, vineyards, and nurseries. The Department of **Microbiology** has proven that our *Agrobacterium* oncogene silencing strategy to produce plants resistant to crown gall is effective in a commercially important species (apple). Other than our oncogene silencing strategy, no effective means exists to prevent or cure crown gall. Our goal is to produce crown-gall-resistant rootstocks for grape, walnut, almond, and fruit trees.

### *IMPACT*

As evaluated by the department of **Botany and Plant Pathology**, the results of this study indicate that epidemic spread may depend strongly on the spatial scale of study. These results may provide one explanation for why cultivar mixtures have sometimes been observed to provide better disease control in commercial fields than in experimental plots. Disease management may need to be considered on a regional basis.

The **Central Oregon Agricultural Research Center** expects that integrated control of *Allium* white rot, a disease which has never been controlled, will soon be possible using integrated methods including fungicides, reduction of pathogen population using germination stimulants, timing of cropping to reduce infection, and (perhaps) biological control. With such integrated methods, we hope to preserve *Allium* production in Oregon, the entire Western U.S. and worldwide -- production which at this time is at high risk of continuation because of this disease.

Once the **Central Oregon Agricultural Research Center** establishes baseline population size and distribution of XCC in carrot fields, they hope to discover points in the disease cycle or epidemiology of bacterial blight in order to both reduce seed contamination and bacterial blight incidence in OR, WA and CA.

As a result of research conducted at the **Central Oregon Agricultural Research Center**, and based on evaluations for ergot control, ergot suppression in Kentucky bluegrass was added to the Tilt label in 1995 and remains the only product registered for control. It is estimated that 1,000 acres of the 5,700 acres in production is affected on an average year. Total savings each year reach \$200,000 for central Oregon growers.

The coordinated temporal regulation of plant and fungal genes will provide clues to which signaling pathways might be involved in plant defense and fungal virulence, respectively. The Department of **Horticulture** predicts that this study will provide novel strategies to manage gray mold diseases in tomato and other crop species.

The Department of **Microbiology** has proven that their strategy to produce plants resistant to crown gall is effective in a commercially important species (apple). The same approach should protect other fruit trees, nut trees, grapevines, cane berries, roses, chrysanthemum, and ornamental nursery plants. Crown gall is a problem worldwide and causes millions of dollars of damage each year in fruit and nut orchards, vineyard, and nurseries. Other than our strategy, no effective means exists to prevent or cure crown gall. Because only rootstocks need protection from crown gall, fruiting wood grafted to gall-resistant rootstock does not need to be genetically engineered. This fact may alleviate consumer concerns regarding genetically modified foods because the fruit from these plants will not contain foreign genes. Because only gene fragments

are needed to trigger gene silencing, which is responsible for the gall resistance trait, even the rootstocks do not contain intact foreign genes. Thus, this technology is extremely safe, effective, and inexpensive.

*SCOPE OF IMPACT* - Pacific Northwest and National

*SOURCE OF FUNDING* – Hatch, State funds, National Institutes of Health, The National Science Foundation, Fulbright grant, USDA Special Grant, and Industry grant

## Key Theme: **Plant Production Efficiency**

### *ISSUE OR PROBLEM*

The focus of one project at the **Central Oregon Agricultural Research Center** will be to provide local producers and regional seed company representatives with the latest unbiased production data for the forage species, varieties and cultural practices such as fertility, weed control, diseases, planting dates, seeding rates, and harvest timings.

One research project conducted in the Department of **Crop and Soil Science** is geared towards soil microbial ecology of an integrated cover crops/reduced tillage vegetable system and on the role of grass seed crops in improving or maintaining soil quality. The purpose of the research is to develop a fundamental understanding on how integrated row cropping systems affect soil biology and other soil properties to develop more sustainable agricultural systems. The potential of soil quality indicators to reflect soil management will be investigated.

Plant seeds are the most important source of agricultural production. The mechanisms of seed development, dormancy and germination are not fully understood. The Department of **Crop and Soil Science** is working to learn more about the principles of seed development and germination.

Additional research conducted by the Department of **Crop and Soil Science** will assist in the development of sustainable and product agriculture systems and will improve the ability of farmers to manage weeds while reducing the potential to contaminate watersheds with both soil and pesticides.

One project conducted by the Department of **Horticulture** studies the plant-governed movement of water and fertilizer ions into the root medium. A plant can govern fertilizer solubilization and uptake if the root system is divided between a capillary water uptake root medium and a fertilizer medium. Plant-governed hydraulic lift of water by roots in the water pouch and outflow from roots in the fertilizer pouch determines fertilizer quantity solubilized. If salinity is phytotoxic, root growth and water outflow will decrease and govern solubilization and ion uptake.

The Department of **Horticulture** also conducts research to increase grower efficiency by reducing inputs of pesticides, water, nutrients, and labor, while increasing the percentage of the production of high quality fruit in the size range demanded by retail markets. To develop rootstocks which result in smaller trees which are easier to prune, train, harvest, control insects and diseases, and produce large, high-quality fruit.

More scientific knowledge is needed to optimize wine grape production and fruit quality in Oregon. Additional research conducted by the Department of **Horticulture** will provide scientific background for optimizing cultural practices for the implementation of Integrated



Production of grapes. Research will be focused on grapevine irrigation and nutrition, evaluation of phylloxera-resistant rootstocks, cultivars and clones, manipulation of carbon production and allocation to advance the onset of ripening, and optimization of fruit composition to improve the commercial viability of the Oregon wine grape industry.

Difficulties to propagate clones of pear, cherry, and hazelnut will be propagated by a new method of tissue culture using solid and liquid media together. A new group of chemicals made by insects cause cell division in certain types of pea. The insect chemicals have been identified and progress is being made to identify the plant chemicals. The pea gene controlling this response will be mapped and cloned by the Department of **Horticulture**.

As evaluated by the **Malheur Experiment Station**, annual weeds and perennial weeds place the profitability and sustainability of agricultural production at risk. Furthermore, intense agriculture in Malheur County depends on the selection of highly productive crop varieties, competitive marketing, practical levels of water and fertilizer inputs, the solution of environmental issues to assure sustainability, and favorable governmental policies. Continued efficient agricultural production requires solutions to these varied and complex problems.

Current research at the **Malheur Experiment Station** focuses on potatoes that require large inputs of fertilizers and pesticides. Even with large inputs, it is difficult to produce potatoes with high yield and excellent processing quality.

The **North Willamette Research and Extension Center** studies the interactions of cultural methods, genotype, and environment on the sustainability of vegetable production.

#### *IMPACT*

Producers, the ultimate end user of the information provided by the **Central Oregon Agricultural Research Center**, can better match the best variety and seeding rate for their individual fields to be planted to alfalfa. They will be able to see the variety fall dormancy and winter hardiness ratings, disease, nematode, insect resistance, and local research based trial data. This information provides better decision making aids for producers to make their alfalfa production enterprise much more sustainable and profitable. Much of central and eastern Oregon depend upon the past and present forage research information that flows out of this program.

The Department of **Crop and Soil Science** has learned that strip till planting of vegetable crops can have negative effects on yield. Their research will determine whether there are measurable effects on soil quality from strip-till planting systems that could be affecting crop yield. This will include combining strip-till planting with cover crops and whether earthworms are important in improving soil quality in strip-till vegetable planting systems.

Characterization of the germination-specific genes produced by the Department of **Crop and Soil Science** will provide us with comprehensive understanding of germination events that are the first step of plant production in the agricultural system. Some of the tools that will be isolated and used in this project such as, gene promoters and reporter gene constructs will be good markers for seed dormancy or germination.

As a result of research conducted in the Department of **Crop and Soil Science**, growers will be able to reduce weed populations and the cost of weed control by changing the time of year that they perform tillage operations. In turn, the number of herbicide applications can be reduced thus lowering the pesticide load in the environment.

As evaluated by the Department of **Horticulture**, the highly efficient plant-governed water uptake (less than 0.1 that applied in overhead sprinkler irrigated systems) and fertilizer solubilization and uptake (~0.015 that applied in open container systems) results in no waste

discharge of fertilizers or other chemical pollutants from the production system and equal or greater plant growth than that in open container systems. The plant raft increases production area by 10-30%. Few pest problems occur, and labor requirements are reduced. The enclosed root systems make it possible to grow plants that can be branded "Pesticide-Free" and "Organically Grown."

Increased knowledge of rootstock, interstem, and cultivar performance allows growers to make wiser decisions when replacing existing plantings. Two of the Horner pear rootstocks offer reduced tree size, increased productivity, and enhanced fruit size. Research conducted by the Department of **Horticulture** also prevents costly mistakes from occurring. Five promising rootstock selections from South Africa (BP-1 and BP-2) and England (708-2, 708-12, and 708-36) are not being recommended to growers due to sensitivity to pear decline.

The Oregon LIVE program has been adopted by an increasing number of vineyards every year. OWAB adopted sustainable viticulture as a goal and this model is moving to other states, particularly California. Based on trials in the Department of **Horticulture**, Oregon grape growers have more information to make educated decisions on rootstock selection for their vineyards. They can adjust their choice to production objectives. Fruit yields can be increased several-fold by rootstock without decreasing quality. Viticulture yields can be increased by changing the pattern of carbohydrate partitioning to favor the harvested portion (the fruit) over unused plant parts. Understanding prioritization of carbon allocation and being able to manipulate it has potential to advance or delay the onset of ripening, increase yields, and improve fruit composition. Soil cultivation of alternate rows was effective in eliminating competition between cover crop and grapevines and is a valid alternative to irrigation where water is not available. Cultivation resulted in increased yeast assimilable nitrogen in the fruit. Irrigation did not significantly improve fruit quality and did not increase juice nitrogen but increased fruit yield.

The identification of bruchins is an important contribution to the important field of plant defense. Peas use bruchins as a signal for the presence of weevil eggs laid on pods. Bruchins are present in very small amounts, but the pea is extraordinarily sensitive to their presence. Bruchin identity gives us another tool to study plant defense, not only to weevils, but how various defense systems interact. Bruchins also stimulate mitosis of mature cells. This is a topic of great importance in biology as it is ultimately related to tumor formation. Also, the cutting and micropropagation methods that the Department of **Horticulture** have developed for pear and cherry rootstocks have facilitated development of clonal rootstocks in these species. Approximately one quarter to a third of a million cherry rootstocks are produced annually based on this work. These are used to produce grafted trees worth millions of dollars. Commercial development of pear rootstocks and hazelnut varieties is less advanced, but our methods have greatly facilitated field testing and commercial testing of these new materials.

The **Malheur Experiment Station** has demonstrated that improved weed control programs result in economic advantages for producers. New herbicide registrations are required for producers to control weeds not manageable with currently registered products. The recent emergency exemption label for dimethenamid-p use in sugarbeet is estimated to save producers in Idaho and Oregon \$23 million. The estimated impact of the registration of metolachlor (Dual Magnum) to control yellow nutsedge in onions is \$5,589,500. The identification of herbicides for controlling noxious weeds in rangeland may improve the carrying capacity of the range for cattle and wildlife and may reduce the loss of native plant species due to uncontrolled spread of introduced exotic species.

Research and demonstrations at the **Malheur Experiment Station** result in more efficient ways to grow a wide variety of crops. Onion quality and marketability is improved as well as the quality of potatoes. Water, fertilizer, and fungicide inputs are economized. Environmental aspects include lower losses of nutrients into streams and rivers due to lower irrigation induced erosion. Innovations are promoting the adoption of innovative drip irrigation systems, which save water and nutrient inputs, while protecting the environment from irrigation-induced erosion and chemical leaching.

The **North Willamette Research and Extension Center** shows that mixed grain/legume winter cover crops contributed nitrogen to certain vegetable crops but were not effective in reducing leaching of nitrate to groundwater. Grain cover crops did not provide nitrogen to the those crops but reduced the amount of nitrate leached following a heavily fertilized crop by up to 50 percent.

*SCOPE OF IMPACT* - State and regional

*SOURCE OF FUNDING* – Hatch, State funds, Local grower groups, OSU Foundation, Agricultural Research Foundation

## Key Theme: **Precision Agriculture**

### *ISSUE OR PROBLEM*

Agricultural producers and providers of agricultural services are now able to obtain large amounts of field specific spatial information. Unfortunately, service providers or management professionals have difficulty converting massive amounts of information into new management plans. The purpose of one project conducted by the Department of **Horticulture** is to provide Oregon's horticultural industries with access to data management procedures to convert what is now unused information into new management plans. The development of protocols to evaluate any new management approach is also important.

### *IMPACT*

The Department of **Horticulture** is convinced that there is more economic gain to be made by managing portions of an orchard according to its needs than coming up with new management techniques that can be uniformly applied to an orchard or field. We want to provide growers with profit, profit potential, and improvement potential maps for their orchards and fields. By allocating resources to areas that are most likely to respond profits can be increased. The combined economic value of the tree crops (Cherries, Hazelnuts, Pears) in the state of Oregon that are being emphasized in this project is 147 million dollars. Even a small percentage increase in profitability will have a substantial impact on Oregon's economy.

*SCOPE OF IMPACT* - State and regional

*SOURCE OF FUNDING* – Hatch, State funds, Local grower groups, OSU Foundation, Agricultural Research Foundation

## Key Theme: **Rangeland/Pasture Management**

### *ISSUE OR PROBLEM*

As assessed by the **Eastern Oregon Agricultural Research Center**, fire regimes have dramatically changed throughout the Intermountain Region, resulting in significant changes in plant community structure and composition. Fire is considered to be the greatest potential threat to sagebrush obligate species such as sage grouse and the primary process leading to the expansion and dominance of exotic weeds. However, the lack of fire is the leading factor attributed to conifer encroachment throughout the West.

Six Agricultural Experiment Station projects are registered for the Department of **Rangeland Resources**. These six projects are at once focused and diverse. All contain the common theme of sustainable ecosystem management coupled with sustainable economic stability. Details allow these projects to focus on wildland plant communities, agroforestry practices, weeds, water quality, biodiversity, adapted plant species management, watershed management, livestock grazing protocols, and groundwater hydrology.

### *IMPACT*

Results from our woodland expansion and fire history research have been directly implemented into long-term fire management plans by the several federal agencies in the Northwest. The plant community-monitoring program developed at the **Eastern Oregon Agricultural Research Center** has been adapted by the USFS and BLM to monitor plant community response following fire.

Results of this research conducted in the Department of **Rangeland Resources**, taken as a whole, have changed the way agriculturists, environmentalists, and agency managers look at natural resources in Oregon, the West, and Beyond. A new understanding is emerging. The strong, positive links between proper management and sustainable environments and economics are becoming increasingly better understood. With global populations rising and environmental function increasingly cherished, the world is on a collision course unless this sort of interaction is understood and practiced.

*SCOPE OF IMPACT* - State and regional

*SOURCE OF FUNDING* – Hatch, State funds, OSU Foundation, Agricultural Research Foundation, and Local grower groups

## Key Theme: **Riparian Management**

*ISSUE OR PROBLEM*

Six Agricultural Experiment Station projects are registered for the Department of **Rangeland Resources**. These six projects are at once focused and diverse. All contain the common theme of sustainable ecosystem management coupled with sustainable economic stability. Details allow these projects to focus on wildland plant communities, agroforestry practices, weeds, water quality, biodiversity, adapted plant species management, watershed management, livestock grazing protocols, and groundwater hydrology.

*IMPACT*

Results of this research conducted in the Department of **Rangeland Resources** have changed the way agriculturists, environmentalists, and agency managers look at natural resources in Oregon, the West, and Beyond. A new understanding is emerging. The strong, positive links between proper management and sustainable environments and economics are becoming increasingly better understood. With global populations rising and environmental function increasingly cherished, the world is on a collision course unless this sort of interaction is understood and practiced.

*SCOPE OF IMPACT* - State and regional

*SOURCE OF FUNDING* – Hatch, State funds, OSU Foundation, Agricultural Research Foundation, and Local grower groups

## Goal 2:

**A safe and secure food and fiber system.** To ensure an adequate food and fiber supply and food safety through improved science-based detection, surveillance, prevention, and education.

## OVERVIEW

### OUTPUT:

Research results have been shared through refereed journal articles, local, regional, national and international meetings.

- Published 13 referred journal articles, one patent, and two meeting proceedings.

### OUTCOMES:

- We identified and measured the concentrations of anthocyanin pigments and polyphenolics in apples, pears, cherries, blueberries, blackberries and potatoes, and also measured their antioxidant activities. We also investigated the effects of variety, processing and post-harvest storage on these compounds. With respect to potential new crops, the anthocyanin pigment composition and antioxidant properties of Chokeberries, *Aronia melanocarpa* and Blue Honeysuckle, *Lonicera caerulea* L. were determined.
- Our research has found that high-pressure treated orange and apple juice had similar sensory and natural antioxidant properties as compared to non-pasteurized juices.
- New profits and employment were generated with the development of a new line of value added single serving raw oysters.
- Research using high hydrostatic pressure has resulted in substantial commercial investment in this technology.
- Time temperature research has allowed albacore producers to improve quality and meet safety standards.
- Fish sauce research produced a new domestic source of sauce; related pasteurization models will allow industry to predict pasteurization temperatures under different package dimensions.

### IMPACTS:

- Research outcomes provided information to plant breeders, food processors and nutritionists have a positive impact on human nutrition and health.
- Blueberry juice processing wastes are a rich source of anthocyanin pigments and polyphenolics which can be recovered for use in nutraceutical and natural colorant

preparations. In addition to providing economic and environmental benefits from by-product recovery, the isolates may also yield nutritional health benefits.

- High pressure studies on non-thermally treated fruit juices provided key information for an industry petition to regulatory agencies to support a claim that such juices are allowed to be marketed as “fresh”.

#### ASSESSMENT:

All units in the Oregon Agricultural Experiment Station are required to conduct annual performance evaluation of their faculty members. These annual reviews are conducted based on goals established during previous year’s reviews. Since all faculty members with OAES FTE are required to establish their station projects, annual performance evaluation serves a good vehicle to assess our progress toward the goals in our plan of work. OAES has made good progress in meeting these goals.

TOTAL EXPENDITURES: \$4,603,335

Hatch- \$63,333

State- \$143,676

Multistate- \$4,396,326

TOTAL FTE: 7.53

#### ACCOUNTABILITY:

Additional information regarding research programs conducted through the Oregon Agricultural Experiment Station may be found in “*Oregon Invests*”, a research accountability database accessible on the web at:

<http://oregoninvests.css.orst.edu>

There are currently over 388 reports contained in the database, searchable by selected criteria. Each report undergoes systematic professional review with analysis of projected economic, environmental and social effects, as appropriate.

Examples of search topics for Goal 2: fiber, food system, food quality, and food safety

### Key Theme: **Food Quality**

#### *ISSUE OR PROBLEM*

The Department of **Bioengineering** is conducting research to improve the quality of fresh fruits and vegetables throughout the postharvest chain as to provide consumers with nutritious and desirable products at affordable prices. Concomitant with quality preservation research will be continued development of energy efficient and cost effective production, handling, storage and transportation systems, equipment and procedures. As sub-projects are completed, additional research opportunities and needs will be identified and addressed.

The seafood industry must evolve from supply oriented production practices to production and marketing strategies which are driven by the needs of domestic and global consumers and downstream market sectors. The **Coastal Oregon Marine Experiment Station** is using new technologies, including time temperature control and high hydrostatic pressure, to produce value added products from aquaculture and wild caught products.

In the Department of **Food Science and Technology**, the thrust of one particular project is to determine the anthocyanin pigment and polyphenolic composition of fruits that are either currently of commercial significance to the Pacific Northwest, or may have commercial potential as future new crops. There is intense interest in these compounds because of their possible health benefits. It is widely accepted that their roles in reducing the risks of coronary heart disease, cancer, and stroke is related to their antioxidant properties. A goal is to develop natural colorants and nutraceutical preparations from fruits or their components, e.g., peel, seeds, and processing by-products, that possess greater functionality and bioactivity.

Fruit juice processing generates substantial waste materials which are under-utilized, commonly being fed to livestock or taken to the sanitary land-fill. Such materials as press-cake residues and centrifuge sediments contain substantial quantities of anthocyanin pigments and polyphenolics which are potential sources for natural colorants and nutraceuticals. Another project in the Department of Food Science and Technology plans to identify and measure the distribution of anthocyanins and polyphenolics in such fruit components as peel, pulp and seeds. Priority will be given to apple, blueberry and blackberry fruits. We will also make natural colorant and nutraceutical preparations by extracting materials generated in pilot plant juice processing trials as well as industrial wastes. Color properties, color stability and antioxidant activities will be determined. (Anthocyanins and polyphenolics are very effective scavengers of free radicals which is believed to be related to a number of their possible health benefits.) Development of natural colorants and nutraceuticals from fruit juice processing byproducts will improve the efficiency of processing operations, provide added value, and be friendly to activities that could lead to increased consumption and expanded market opportunities for these agricultural commodities.

### *IMPACT*

The Department of **Bioengineering** has found that the verification of air flow patterns with and without flow enhancing nozzles supports previous findings that bin stacking patterns, especially underneath evaporator units is critical to establishing uniform air distribution throughout the storeroom. Adoption of improved bin stacking schemes will reduce localized areas of fruit quality loss, result in overall quality improvement, and thereby increasing profits.

Nisbet Oyster Co. Inc. joined with the **Coastal Oregon Marine Experiment Station** to develop a recently introduced Oyster Shooters line of single-serving raw oysters. This product will attract a new market segment, add value, and increase profit margins. Several other entrepreneurs in the industry have begun value-added product ventures. The work with high pressure processing in oysters has also led to substantial commercial investment in this technology and work will continue for adding value and safety to seafood products. Recovery of proteases from surimi wash water has shown that useful compounds can be made from seafood by-products. The albacore value-added product study has provided the industry with important parameters for onboard handling systems. The time/temperature work has been used by both industry and federal agencies for maintaining quality and safety parameters in albacore tuna.



Research performed by the Department of **Food Science and Technology** has provided plant breeders, food processors and nutritionists with information that should have a positive impact on human nutrition and health. Anthocyanin pigments and polyphenolics are natural antioxidants, which are believed to play a major role in the health benefits provided by fruits and vegetables. We identified and measured the concentrations of these compounds in apples, cherries, blueberries, blackberries and potatoes, and also measured their antioxidant activities. We also investigated the effects of variety, processing and post-harvest storage on these compounds. We have developed natural colorants from radishes and red-fleshed potatoes that exhibit superior color and stability properties.

The Department of **Food Science and Technology** has also identified blueberry juice processing wastes as a rich source of anthocyanin pigments and polyphenolics that can be recovered for use in nutraceutical and natural colorant preparations. In addition to providing economic and environmental benefits from by-product recovery, the preparations may also give nutritional health benefits.

*SCOPE OF IMPACT* - National and international

*SOURCE OF FUNDING* – Hatch, State funds, Northwest Center for Small Fruit Research, USDA Germplasm Repository, USDA Human Nutrition Laboratory, Commodity groups

## Key Theme: **Food Safety**

### *ISSUE OR PROBLEM*

Fresh Northwest berries and their juices and purees have challenged the belief that high acid foods cannot harbor viable pathogenic bacteria. They could also act as a vector for foodborne illness. The Department of **Food Science and Technology** is performing research to enhance and ensure the safety of Northwest fresh and processed berries through integrated research, education and Extension efforts.

While over 98% of the juices consumed in the U.S. are pasteurized, the popularity of unprocessed and organic foods is growing. Unprocessed juices have a higher risk of containing potentially harmful bacteria such as Salmonella and Escherichia coli-015:H7 transmitted to humans through contaminated fruit. At-risk consumers of such beverages include children, senior citizens, pregnant women, and those with weakened immune systems. Several outbreaks of E. coli-015:H7 in the 1990's were confirmed as most likely caused by juices that were not pasteurized, or otherwise processed to eliminate harmful bacteria. The tighter regulatory environment for pasteurization of fruit and vegetable juices as mandated by the FDA requires a 5-log reduction of microbial pathogens. Many consumers prefer unpasteurized juice because of its superior taste, and believe that the pasteurization process destroys natural antioxidants and enzymes, which are important for maintaining good health. Consequently, this has created a commercial opportunity for non-thermal pasteurization of juices using technologies such as high pressure processing. In response to industry interest in pressure-processing fresh juices, the Department of **Food Science and Technology** conducted a large sensory evaluation test in collaboration with Dr. Mina McDaniel. This test was conducted to demonstrate whether consumers could distinguish untreated and pressure-processed juices. We also monitored concentrations of natural antioxidants to see whether they were affected by pressure treatments.

## *IMPACT*

The following impacts are expected through the implementation of research performed by the Department of **Food Science and Technology**: 1) to improve the microbial safety of Northwest fresh berries and berry products, such as juice and puree; 2) to strengthen students' understanding in food safety, sanitation, and HACCP; and 3) to develop scientifically-based technologies for disinfecting fresh berries and achieving 5-log reduction in targeted pathogens in fruit juice and puree.

Research conducted by the Department of **Food Science and Technology** provided key supporting information for an industry petition to regulatory agencies for the claim that high pressure-treated juices should be allowed to carry the market label "fresh." Two sets of sensory panels conducted with 101 and 221 consumers of apple and orange juice, respectively, demonstrated that panelists found pressure treated juice to be indistinguishable from untreated controls. Chemical analysis showed that natural antioxidants in these juices were not affected by pressure processing achieving the mandatory 5-log reduction. Consumers will benefit from having on the market a product that is safe AND meets their "freshness" quality expectations.

SCOPE OF IMPACT – National

SOURCE OF FUNDING – Hatch, State funds

### **Goal 3:**

**A healthy, well-nourished population.** Through research and education on nutrition and development of more nutritious foods, enable people to make health promoting choices.

### **OVERVIEW**

#### **OUTPUT:**

Research results have been shared through refereed journal articles, abstracts, books and book chapters; theses, local, regional, national and international meetings, symposia and workshops.

- Published 6 referred journal articles, 3 abstracts, and one meeting proceeding.

#### **OUTCOMES:**

- On-going research focused on vitamin B-6 has been critical in understanding the varied role this particular nutrient plays in human health.
- Research on the use of calcium phosphate compounds to fortify foods and the potential detrimental effects on bone health has developed into the recommendations for non-phosphorus calcium compounds to be used to fortify foods.
- A laboratory rodent model for studying potential for maternal diet to reduce movement of carcinogens across the placenta was developed.
- Protein interactions that underlie DNA base excision repair were defined.
- Information on human pesticide exposure was collected and provided to the United States Environmental Protection Agency Office (USEPA) of Pesticide Programs.

#### **IMPACTS:**

- Progress in these projects will improve choices of regulatory and clinical scientists for promoting health of people applying pesticides, pregnant mothers, and the general public through identifying new targets for drug intervention.
- Findings on vitamin B-6 have been instrumental in establishing the newly published Recommended Daily Intakes (RDI) for this nutrient. Research from OSU was cited extensively in the DRI documents.
- Validation of a nutritional education program assisted young adults to increase fruit and vegetable consumption to improve health and will impact the market for produce.

- USEPA considered information we provided in regulatory decision making for pesticides.

#### ASSESSMENT:

All units in the Oregon Agricultural Experiment Station are required to conduct annual performance evaluation of their faculty members. These annual reviews are conducted based on goals established during previous year's reviews. Since all faculty members with OAES FTE are required to establish their station projects, annual performance evaluation serves a good vehicle to assess our progress toward the goals in our plan of work. OAES has made good progress in meeting these goals.

TOTAL EXPENDITURES: \$407,510

Hatch- \$34,021

State- \$364,359

Multistate- \$9,130

TOTAL FTE: 2.65

#### ACCOUNTABILITY:

Additional information regarding research programs conducted through the Oregon Agricultural Experiment Station may be found in "*Oregon Invests*", a research accountability database accessible on the web at:

<http://oregoninvests.css.orst.edu>

There are currently over 388 reports contained in the database, searchable by selected criteria. Each report undergoes systematic professional review with analysis of projected economic, environmental and social effects, as appropriate.

Examples of search topics for Goal 3: human health, and human nutrition.

### Key Themes: **Human Health**

#### *ISSUE OR PROBLEM*

Accumulation of DNA damage and mutations play an important role in the etiology of human disease, congenital birth defects, neurological dysfunction, neoplasia, and biological aging. Uncontrolled introduction of uracil residues into the DNA genome has been shown to produce cytotoxic, mutagenic, and lethal consequences. Research conducted in the Department of **Environmental and Molecular Toxicology** will elucidate the enzymology, mechanism of action, and biological impact of uracil-DNA repair as related to the human cellular defense system(s) designed for mutation avoidance.

Thirty-five percent of all cancers may be prevented by diet. The fetus is very susceptible to cancer caused by exposure to chemicals during pregnancy. No information is available on the potential for phytochemicals in the mother's diet to prevent cancer in her offspring. An additional project conducted by the Department of **Environmental and Molecular Toxicology** examines

the potential for three of the major phytochemicals known to prevent cancer in protection of the fetus against liver and lung cancer caused by maternal exposure to chemical carcinogens.

#### *IMPACT*

Uracil-mediated base excision DNA repair provides a strategic cellular defense mechanism for maintaining the genetic stability of the human genome. Since the accumulation of DNA damage and mutations play an important role in the etiology of various human diseases, congenital birth defects, neurological dysfunction, neoplasia, and biological aging, elucidating the mechanism of action of uracil-DNA repair is relevant to understanding the causes of human disease. The basic research conducted by the Department of **Environmental and Molecular Toxicology** during the past year has yielded significant findings concerning (1) the ability of alternative uracil-DNA repair pathways to conduct BER; (2) the kinetic mechanism of Ung to extract uracil from DNA; and (3) the role of Arg276 in UNG activity and DNA binding. As a consequence, fundamental and relevant insights have been gained that allow a deeper understanding of the biochemical pathways associated with mutation avoidance. This research generates fundamental new information that contributes to the knowledge base of the biomedical research community and associated biotechnology industry. This information may be important for new drug development and design. Understanding the molecular mechanism of uracil-DNA repair has the potential to significantly contribute to better diagnostics, prevention, or intervention strategies for combating human diseases.

Cancer chemoprevention through optimal diet and/or diet supplementation promises to reduce the cost and suffering associated with this disease. The Department of **Environmental and Molecular Toxicology** is targeting the fetus for protection from cancer-causing chemicals capable of crossing the placenta. In addition to protecting against cancer, this strategy may also reduce the risk of chemically-dependent birth defects.

*SCOPE OF IMPACT* - State and national

*SOURCE OF FUNDING* - Hatch, State funds

### Key Themes: **Human Nutrition**

#### *ISSUE OR PROBLEM*

Use of calcium phosphate compounds to fortify foods with calcium adds phosphorus to a diet already high in this element. Because high phosphorus intakes can be detrimental to bone health, The Department of **Health and Human Sciences** recommends that non-phosphorus calcium compounds should be used to fortify foods.

#### *IMPACT*

The Department of **Health and Human Sciences** is conducting three individual sub-projects. Project A will define the effect, mechanism and significance of nutrient interactions involving fluoride, calcium, magnesium and chloride. Project B adds new information to foods that

contribute to total fluoride intake. Project C describes the significance of trace element function under conditions of extreme physical activity. The information provided by all three projects is intended to increase our understanding of human nutrient requirements.

*SCOPE OF IMPACT* - State and national

*SOURCE OF FUNDING* – Hatch, State funds

#### **Goal 4:**

**Greater harmony between agriculture and the environment.** Enhance the quality of the environment through better understanding of and building on agriculture's and forestry's complex links with soil, water, air, and biotic resources.

#### **OVERVIEW**

##### OUTPUTS:

Research results have been shared through refereed journal articles, abstracts, books and book chapters; theses, local, regional, national and international meetings, symposia and workshops.

- Published 52 refereed journal articles and four books.
- Developed five workshops for natural resources professionals in state and federal agencies.
- Made 68 presentations at state, regional and national scientific conferences.
- Established a regular newsletter and a WEB based information site.

##### OUTCOMES:

- Key outcomes relating to land use include: 1) the use of a dynamic economic supply and demand model of urban development to examine the dynamics of land use change at the rural/urban interface; 2) analysis indicating that stricter land use regulations result in a reduction in the rate of agricultural land converted to urban uses as well as lower long run per capita public expenditures and property taxes; 3) analysis of the effects of open space policies on urban growth patterns; and 4) analysis indicating that forest land use policy can be designed to enhance environmental benefits.
- The research has led to new developments in our understanding of plant growth and development and the mechanisms of several diseases. For example, proteins required for suppression of plant defenses to viral infections were identified, genes involved in susceptibility to viruses were characterized, the genome sequence of a bacterial pathogen was determined, and fungal pathogenicity factors were further characterized. The importance of plot size to the spread of disease epidemics was revealed, biological control of fire blight was enhanced.
- Research on southern right whales and humpback whales will reveal where these animals go during summer feeding seasons and sperm whale research will resolve whether these animals are detrimentally affected by underwater acoustic busts used for oil and gas exploration. The work improves management and recovery of endangered whales.
- Research has focused on determining methodologies to accurately predict nitrogen and phosphorus bioavailability from decomposition of yard debris, biosolids and other non-traditional organic materials. Work has been at both the macro and micro scales. Researchers have shown that traditional agronomic soil phosphorus tests correlate well with more elaborate environmental test procedures. Researchers have shown that tests for Fe and

Mn in groundwater can be compromised by procedures that do not exclude oxygen during sampling. An argon-purged well sampling procedure has been developed that significantly improves reliability of data. Soil microbiologists have demonstrated that secondary mass spectrometry can be used to measure the isotopic composition of individual microorganisms. This ability could revolutionize studies of nutrient flux on a microscale.

- The persistence of diuron in soil and slight mobility in groundwater was demonstrated. Methods for monitoring and enhancing degradation of organic contaminants in groundwater were developed.
- Controlling runoff of agricultural soils to reduce diuron movement to surface water was initiated. Chemical markers for measuring contaminant degradation rates in groundwater were validated in the field.
- Results from these projects cover a diverse range of species, habitats and resource issues. Several studies identify and rank the relative importance of different habitats or habitat components for fish and wildlife species. Three studies developed models predicting the change in animal populations or distributions as a result of harvest, contaminants, or land management activities. One project provided an explicit spatial representation of the current ecological and social conditions for the 30,000-km<sup>2</sup> Willamette Basin, as well as historical and future conditions.

#### IMPACTS:

- Land use research is being used by policy makers to review local land use policies (Portland Metro) and state land use policies (DCLD and OWEB). The economic analysis of alternative water allocation regimes in the Klamath Project has helped inform the debates during the recent controversy about water allocation policies in the Klamath. This work also provided the foundation for on-going economic analysis of more comprehensive approaches to address the water quality and allocation issues in the basin.
- Work on biological control, nematocide trials, disease epidemiology will have immediate impacts on agricultural in Oregon and elsewhere. Work on the basic mechanisms of viral, bacterial and fungal diseases is laying the foundation for future strategies to combat diseases. Projects directed towards understanding mechanisms of plant growth and development are enhancing the knowledge base necessary to make improvements in yield, nutritional value, disease resistance, and other desirable properties of plants.
- Knowing that standard agronomic tests can be used to assess phosphorus levels in an array of soil systems allows land managers to use more readily available and often less costly testing. This should increase testing efforts across the nation and enhance efforts to reduce eutrophication of surface waters. Use of research technologies developed by OSU researchers should enhance ability to more accurately sample Fe and Mn levels in soils-water systems and to understand the role of microbes in nutrient cycling.



- Progress in technologies for controlling movement of pesticides and other contaminants in surface water and groundwater greatly reduce impacts of essential economic activities on environmental quality.
- Oregon Department of Fish and Wildlife is using our research results in identifying areas for reintroduction of extirpated species. Several projects have also been instrumental in developing recovery plans or reviewing listing proposals for several threatened and endangered species. Other results have influenced some of the decision-making processes and management practices on federal lands in Oregon.
- The use of chlorpyrifos has been reduced by developing spatial information for selecting planting locations based on risk, better monitoring of insect development and improved regional sanitation practices.

#### ASSESSMENT:

All units in the Oregon Agricultural Experiment Station are required to conduct annual performance evaluation of their faculty members. These annual reviews are conducted based on goals established during previous year's reviews. Since all faculty members with OAES FTE are required to establish their station projects, annual performance evaluation serves a good vehicle to assess our progress toward the goals in our plan of work. OAES has made good progress in meeting these goals.

TOTAL EXPENDITURES: \$6,497,730

Hatch- \$368,216

State- \$5,957,308

Multistate- \$172,206

TOTAL FTE: 22.78

#### ACCOUNTABILITY:

Additional information regarding research programs conducted through the Oregon Agricultural Experiment Station may be found in "*Oregon Invests*", a research accountability database accessible on the web at:

<http://oregoninvests.css.orst.edu>

There are currently over 388 reports contained in the database, searchable by selected criteria. Each report undergoes systematic professional review with analysis of projected economic, environmental and social effects, as appropriate.

Examples of search topics for Goal 4: environment, waste management, biological control, biodiversity, endangered species, forest resources, climate change, integrated pest management, soil quality, sustainable agriculture, wildfire, and water quality.

**Key Theme: Endangered Species**

### *ISSUE OR PROBLEM*

Our planet's large whale species are still endangered despite the current moratorium on whaling. Anthropogenic issues such as ship strikes, fishing entanglement and pollution continue to threaten their recovery. It is vital to protect the habitats most important to their recovery, yet for many species, these critical habitats are not known. The purpose of one project conducted by the **Coastal Oregon Marine Experiment Station** is to determine and characterize the critical habitats of endangered whales in order to enable wise management decisions and assist in the survival and recovery of depleted populations.

### *IMPACT*

For the first time, whale and humpback whale research conducted at the **Coastal Oregon Marine Experiment Station** will reveal where these animals go during their summer feeding seasons. Armed with this information, we are far better equipped to protect and conserve the feeding grounds of these stocks. Sperm whale research will help to resolve the current controversy over whether or not these animals (and, by extrapolation, other toothed cetaceans) are detrimentally affected by the underwater acoustic bursts used for oil and gas exploration.

*SCOPE OF IMPACT* - Oregon, national, and international

*SOURCE OF FUNDING* – Hatch, State funds, U.S. Environmental Protection Agency, National Science Foundation, U. S. Bureau of Reclamation

## Key Theme: **Natural Resources Management**

### *ISSUE OR PROBLEM*

The Willamette River watershed is a highly modified agricultural and urban ecosystem. Future projections suggest that the population will double over the next 50 years, yet public demand for environmental quality will remain high, challenging land-use planning and policy decisions. The Department of **Fisheries and Wildlife** sought to understand historic and basic contexts of stream networks, integrating long-term observations, field experiments, historical databases, spatial analysis, modeling, & evaluation of future scenarios of ecosystem change. Research areas include 1) longitudinal patterns of fish, wood, & riparian vegetation, 2) fish population responses to habitat conditions and disturbances, 3) trajectories of landscape change, and 4) restoration ecology.

### *IMPACT*

Research by the Department of **Fisheries and Wildlife** provides an explicit spatial representation of the current ecological and social conditions for the 30,000-km<sup>2</sup> Willamette Basin, as well as historical and future conditions. Conservation measures that stakeholders found likely over the next 50 years reversed the trends in resource decline and restored approximately one-third of the ecological functions that had been lost over the last 150 years. Future alternatives for this basin differed substantially in the allocation of land for agriculture, urban

and residential use, and forestry. Complex environmental problems of the future will require these types of landscape-level, multidisciplinary analyses involving scientists, resource managers, citizens, and decision makers. The results of this study are being used extensively by the Willamette Restoration Initiative and the Oregon Plan for Salmon and Watersheds. The project maintains a website from which the public can download data on the natural resources of the basin (<http://oregonstate.edu/dept/pnw-erc/>).

*SCOPE OF IMPACT* - National and international

*SOURCE OF FUNDING* – Hatch, State funds, USDA competitive grants, U.S. National Park Service, U. S. Forest Service, Oregon Department of Fish and Wildlife

## Key Theme: **Nutrient Management**

### *ISSUE OR PROBLEM*

Certain agricultural practices contribute to the problem of nitrate in water. The department of **Botany and Plant Pathology** examines the basic underpinnings of the microbial processes involved in nitrate production.

Byproducts from farms, industry, and cities have nutrient value for crop production, but careful management practices are needed to protect environmental quality. The Department of **Crop and Soil Science** is working to develop guidelines for appropriate utilization of byproducts to protect environmental quality and to provide economical alternatives to landfill disposal or incineration.

### *IMPACT*

As evaluated by the department of **Botany and Plant Pathology**, the complete genome sequence of *Nitrosomonas europaea* was completed and is now available to inform studies of all aspects of the growth, metabolism, and ecology of this organism. The genome sequence has challenged long-standing theories on the mechanism of obligate lithotrophy. Growth of the organism with fructose as the carbon source reveals that the organisms are not obligate autotrophs as was believed for over 100 years.

The Department of **Crop and Soil Science** uses their knowledge to formulate guidance for agronomic rates for land application of biosolids and other municipal, industrial and agricultural byproducts. Scientifically-based guidance provides economic benefits for byproduct generators and farmers, and assists in the protection of the environment from excessive nutrient applications.

*SCOPE OF IMPACT* - Local, state, and national

*SOURCE OF FUNDING* – Hatch, State funds, Commodity groups, USDA, EPA

## Key Theme: **Soil Quality**

### *ISSUE OR PROBLEM*

Although it is well known that mineralization and immobilization of nitrogen can occur simultaneously in soil, it is not known what soil properties are essential for these activities to coexist. In most situations, mineralization exceeds immobilization. The purpose of one research project conducted by the Department of **Crop and Soil Science** is to gain a better understanding of the soil conditions, and the nature and location of key microbial species that play crucial roles in coupling the nitrogen cycling processes that are essential for maintaining crop productivity and enhancing soil quality.

### *IMPACT*

Nitrogen management continues to be a challenge to our cropping systems in western Oregon where excessive rainfall and mild winters are conducive to excess nitrogen mineralization and leaching. Nitrogen management becomes even more complex as agroecosystems incorporate more organic nitrogen containing residues, and as soil organic matter sequestration and soil structural properties change with improved conservation practices. Research conducted by the Department of **Crop and Soil Science** will lead to the development of improved nitrogen cycling models that will help us to better understand how soil and climatic factors influence the fate of organic nitrogen added to soils. Improving the management of nitrogen in agricultural soils has both economic and environmental benefits, especially in landscapes and under climatic conditions where nitrate run-off is severe.

*SCOPE OF IMPACT* - Local and regional

*SOURCE OF FUNDING* - Hatch, State funds, USDA-SARE

## Key Theme: **Sustainable Agriculture**

### *ISSUE OR PROBLEM*

The sustainability of beef cattle production in the Western US may hinge on their ability to reduce winter feed costs and demonstrate sustainable grazing practices on public and private rangelands. Research at the **Eastern Oregon Agricultural Research Center** evaluates alternative winter management strategies and grazing management strategies that may offer tools and (or) to address these problems.

As assessed by the Department of **Environmental and Molecular Toxicology**, economically and environmentally sustainable agriculture requires an integrated approach to pest management. Judicious use of agrochemicals demand practical knowledge of their fate and effects in agricultural and natural ecosystems. A mechanistic approach will allow for development of novel physical and biological analytical techniques to assist in ascertaining fate and effects. This new knowledge is required for the advancement of science-based management strategies which prevent or mitigate unacceptable adverse impacts on human and environmental health, the goal of the W-45 Committee.

## *IMPACT*

Research performed at the **Eastern Oregon Agricultural Research Center** will aid beef producers in designing beef production systems that are both economically and ecologically sustainable. Alternative winter-feeding strategies that reduce winter feed costs will be essential for western beef producers to stay competitive in a global market. Likewise, because of the reliance of western beef producers on public and private rangelands, grazing systems that promote ecological sustainability will be critical to the continued use of rangelands in beef production systems.

The major finding, as a result of the research conducted in the Department of **Environmental and Molecular Toxicology**, is that diuron is persistent in soil and does not move into groundwater. Efforts aimed at controlling runoff will be most likely to reduce the surface transport of diuron to waterways.

*SCOPE OF IMPACT* - Local and regional

*SOURCE OF FUNDING* – Hatch, State funds, USDA Western Region Integrated Pest Management Grants, Special grants, Agricultural Research Foundation

## Key Theme: **Water Quality**

### *ISSUE OR PROBLEM*

TMDLs are being imposed by U.S. courts and the USEPA to set water quality standards all over the country. USEPA blames agriculture for the majority of non-point source pollution in the country. Research at the **Malheur Experiment Station** feels it is essential that the TMDLs be based on sound science, and that they protect natural resources without an undue burden on tax payers or producers.

### *IMPACT*

As evaluated by the **Malheur Experiment Station**, the draft mid-Snake River TMDL sets a goal of 0.07 mg/L total phosphorus for Malheur River water entering the Snake River. Rather high in the Malheur Watershed, before the influences of cities or row crop irrigation, total phosphorus average roughly three times the TMDL limits. At analogous locations in the Boise River to the east, total phosphorus levels are very low. The presence of high total phosphorus in Malheur River water at locations high in the watershed suggests geological sources of phosphorus. If these sources exist, they have not been identified. An understanding of phosphorus enrichment of the Malheur River is needed to determine feasible phosphorus concentration goals.

*SCOPE OF IMPACT* – Local, state, and national

*SOURCE OF FUNDING* - Hatch, State funds, USDA competitive grants, Industrial commodity commissions

## **Goal 5:**

**Enhanced economic opportunity and quality of life for Americans.** Empower people and communities, through research-based information and education, to address economic and social challenges facing our youth, families, and communities.

## **OVERVIEW**

### **OUTPUTS:**

Research results have been shared through refereed journal articles, abstracts, books and book chapters; theses, local, regional, national and international meetings, symposia and workshops.

- Published 13 referred journal articles, one book, two book chapters.
- Made two national research presentations.
- Prepared several policy briefs and distributed to policymakers.
- Developed, analyzed and published strategies and methods for tracking outcomes for community child care programs.
- Developed an outcome accountability model and refined for measuring child, youth and family programs of prevention program initiatives

### **OUTCOMES:**

We have begun to understand how rural poverty differs from urban poverty and some of the implications for welfare policies. We are beginning to better understand the structure of rural economies – rural economies are often quite different from each other, but individually are much less diversified than urban economies; they typically are unable to exploit cluster economies; business retention and expansion is a much more viable development strategy than targeting new firms; and economic thresholds, though not well understood, are important considerations in maintaining existing industries and in creating viable new development.

### **IMPACTS:**

- The Klamath economic impact analysis is being used by Congressional staff to better understand the impacts of the 2001 water curtailment and to help design alternative policies.
- The Oregon Legislative Revenue Office is using the Oregon Tax Incidence Model to evaluate the size and progressivity of alternative state tax structures.
- The Oregon Department of Housing and Community Services is using the Oregon Poverty Dynamics Simulation model to better understand Oregon poverty and welfare policy.
- Congressional staff and policy analysts were briefed on the barriers to working facing low-income adults in rural areas and the differential impacts of welfare reform in rural and urban areas.

- Our results accountability model and related resources are the basis of the performance measurement policies and practices for the Oregon Commission on Children and Families and all 36 county commissions, the Oregon statewide planning processes for children, youth and families under SB555 (2000 Oregon Legislative Assembly); the Oregon Child Care Bureau; the federal DHHS/ACF Child Care Bureau, the National Association of Child Care Resource and Referral Agencies. In addition, United Way agencies in several states have used the model

#### ASSESSMENT:

All units in the Oregon Agricultural Experiment Station are required to conduct annual performance evaluation of their faculty members. These annual reviews are conducted based on goals established during previous year's reviews. Since all faculty members with OAES FTE are required to establish their station projects, annual performance evaluation serves a good vehicle to assess our progress toward the goals in our plan of work. OAES has made good progress in meeting these goals.

TOTAL EXPENDITURES: \$149,678

Hatch- \$11,601

State- \$108,140

Multistate- \$29,946

TOTAL FTE: 0.77

#### ACCOUNTABILITY:

Additional information regarding research programs conducted through the Oregon Agricultural Experiment Station may be found in "*Oregon Invests*", a research accountability database accessible on the web at:

<http://oregoninvests.css.orst.edu>

There are currently over 388 reports contained in the database, searchable by selected criteria. Each report undergoes systematic professional review with analysis of projected economic, environmental and social effects, as appropriate.

Examples of search topics for Goal 5: rural, low-income families, community development, and employment.

### Key Themes: **Children, Youth, and Families at Risk**

#### *ISSUE OR PROBLEM*

Rural communities have a high percent of families living in and near the poverty levels. In order for rural communities to be strong and viable, they need strong and healthy families. Rural families face many economic challenges. Changes in the welfare reform system to the states have created a dynamic multifaceted environment that provides challenges and opportunities to families, communities, and public agencies as they move into the 21st century.

Critics of welfare reform have expressed fear that many families in rural areas will have a lower level of living after leaving welfare because of inadequate employment opportunities, lack of transportation systems and child care facilities, and limited private sector support systems in their communities. Thus, families in poverty will increase and those near poverty will also be affected. Proponents of welfare reform project that the families will integrate successfully into the work world and become self-reliant citizens of their communities; in turn, their children will be economically self-sufficient. The transition from welfare-to-work is complicated by devolution with each state having different welfare reform policies. Little information is available in rural communities from low-income families to analyze and to track their well-being in the context of welfare reform. A study conducted by the Department of **Health and Human Sciences** will provide the opportunity to document welfare reform impacts from the perspectives rural family members, within their community context, and across communities with differing social support policies and provisions. This project will provide insights to agencies and policy makers as they adjust welfare reform to enhance and change rural family functioning within their rural communities.

The outcome accountability model developed and refined under another project conducted by the Department of **Health and Human Sciences**, guides the development of measurable outcomes for children, youth, and family programs. Communities, agencies, and programs use the model to align specific outcomes with important social policy goals, to define evidenced-based strategies for achieving these outcomes, and to track progress toward selected outcomes. During 2002, this model was addressed through identification and refinement of measures to track outcomes of community wide prevention initiatives for children and youth. A full report was completed and will be distributed statewide by the Oregon Commission on Children and Families in early 2003. Also, focus group and key informant interviews were conducted to examine factors associated with the level of implementation of outcome-focused accountability in initiatives serving children, youth, and families. Follow-up interviews will be scheduled for spring 2003.

### *IMPACT*

Research conducted in the Department of **Health and Human Sciences** is providing an in-depth picture of low-income families living in rural communities. Our work indicates that most rural poor families are working, although many are not able to secure full-time employment. Despite working, nearly all have difficulty making ends meet. Many families in our sample are food insecure. A recent analysis of mother-daughter relationships highlighted the important supports that mothers provide to their daughters. In some families, however, the provision of extensive supports may place demands on daughters that limits their ability to escape poverty. With the collection of Year-2 data, we will be able to describe longitudinal changes in low-income rural families as the recession deepens. Our work has implications for the reauthorization of TANF legislation, now under consideration in Congress. Several policy briefs by members of the research team have been prepared and distributed to policymakers. In addition, our findings have implications for educational programs for low-income families.

The outcome accountability model produced by the Department of **Health and Human Sciences** forms the basis of Oregon statewide planning and performance measurement by the Oregon Commission on Children and Families and all 36 Oregon county commissions. This model has been fully adopted as the basis of evaluation of Oregon Healthy Start, the state's largest children maltreatment prevention initiative. This model has also been adopted by the



Oregon Child Care Bureau, the federal DHHS/ACF Child Care Bureau, and the National Association of Child Care Resource and Referral Agencies. In addition, United Way agencies in several states have used this model.

#### *SCOPE OF IMPACT - National*

*SOURCE OF FUNDING* – Hatch, State funds, B.E. Knudson Endowment for Family Policy, Sub-contract from the Oregon Child Care Research Partnership funded by the USACF Child Care Bureau

### **Key Themes: Impact of Change in Rural Communities**

#### *ISSUE OR PROBLEM*

The 2001 water curtailment by the Bureau of Reclamation to the Klamath Reclamation Project created a crisis that focused national attention on the interrelationships between agricultural production, the environment and rural economies. Faculty from the Department of **Agricultural and Resource Economics** combined forces with extension faculty to study the impacts of the water curtailment on farmers and the local economy. The purpose was to help residents and policy makers better understand the impacts and interrelationships as a basis for dealing with future water shortages in a less disruptive and costly manner.

As assessed by the **Eastern Oregon Agricultural Research Center**, the management of public lands deeply divides rural communities affected by land management policies. Changing land management alternatives to meet societal objectives means changing the allocation of economic resources regionally and locally and the alteration of the social and cultural importance of public lands to local communities. Questions of direct and indirect economic and social impacts to resource users, households, employers, local governments, and others remain of key concern to local, state, and national policy makers.

The department of **Statistics** collaborated with five other land grant universities on research with the goal of improving surveys on agricultural issues.

#### *IMPACT*

Farmers and politicians better understand the controversial economic implications of the decision to curtail water to the Klamath Irrigation Project. The calculated impacts were smaller than the irrigators claimed, but larger than the environmental interest groups had claimed. Furthermore, economic analysis indicated that the same environmental outcome could have been achieved at approximately one-fifth of the cost. Faculty from the Department of **Agricultural and Resource Economics** met with various stakeholders on numerous occasions to discuss alternative solutions to address the water and habitat problems in the Upper Klamath Basin. The output from these efforts (OSU reports, NRC Interim Report) have been helpful in framing the questions in the Basin and in developing long term management options for the water management agencies. For example, the NRC interim report has been cited by the agencies as the basis for current operating plans.

Research conducted at the **Eastern Oregon Agricultural Research Center** will not solve the public land management dilemma, but it will provide scholarly research, extension and

educational programs that will improve the knowledge base upon which public land management decisions are made. The potential impacts of alternative management options will be evaluated and educational programs provided to inform policy makers and the general public about the potential impacts to rural communities and regional economies. Consistent economic models will be developed for various western states so that future requests for impact assessment and input can be accomplished in a timely manner.

Research from the department of **Statistics** has provided methods for improving response rates in mail surveys.

*SCOPE OF IMPACT* - Local, statewide and national

*SOURCE OF FUNDING* – Hatch, State funds

## Key Themes: **Jobs/Employment**

### *ISSUE OR PROBLEM*

Work is increasingly round the clock and round the globe. In a project conducted by the Department of **Health and Human Sciences**, women whose jobs involve extensive travel are studied to see how they combine their jobs with their personal and family lives. Results yield benefits to organizations whose employees must travel, as well as to the individuals who manage intensive job travel with their personal lives. The purpose of this project is to learn more about the personal and work lives of women whose jobs require extensive travel.

### *IMPACT*

From detailed analyses of the lives of women who travel for work, recommendations for employer policies are drawn that benefit women's lives and enhance employee retention, as well as help remove the glass ceiling. Specific strategies to assist women as they manage their lives around intensive work schedules are also developed by the Department of **Health and Human Sciences**.

*SCOPE OF IMPACT* - Local, statewide and national

*SOURCE OF FUNDING* – Hatch, State funds

## **B. Stakeholder Input Process**

**Actions Taken to Seek Stakeholder Input and Encourage Their Participation:** At Oregon State University, College of Agricultural Sciences, there are several formal avenues for soliciting stakeholder contributions. These include:

1. Dean's Advisory Council - This is a small advisory council composed of industry, consumer, and environmental representatives. It is advisory to the dean of the College of Agricultural Sciences.

2. Dean's Legislative Advisory Council - This is usually a sub-group of the Dean's Advisory Council providing input as legislative budgets are prepared for submission to state government.
3. Advisory Councils of each department and branch station - These groups are advisory to the departments and branch stations and include membership drawn from the discipline or relevant region.
4. Advisory Councils of each county extension office - These advisory groups are more broadly based and relate to all Extension program areas in a county or region. Agriculture is one of the Extension program areas.
5. Board on Agriculture of the Oregon Department of Agriculture (i.e., the State Department of Agriculture) - This is a statewide advisory board for agriculture and is appointed by the governor. The dean is a permanent appointee to this board.

These councils meet regularly to aid in the direction and guidance of our programs. Leaders from each industry and commodity group are typically invited to serve on the Advisory Councils. We also seed community, consumer and environmental representatives.

In addition to formal advisory councils, unit leaders in the departments, branch stations and counties maintain regular contacts with stakeholders throughout the year.

This past March, OSU's College of Agricultural Sciences and about 40 Oregonians who work in natural resource industries or for organizations focused on natural resources, gathered for a two-day event in Salem. The purposes of the meeting were for these College "stakeholders" to: develop a common understanding of the challenges the College faces as it makes budget and program reductions, review budget and program options the College explored and adopted to address the required reductions, as well as discuss and understand those options and actions, and to consider key strategic questions and provide counsel to Dean Thayne Dutson and the College's senior administration that will guide future budget, program, and organizational decisions. The College representatives listened while stakeholders offered them counsel on the budget reduction situation and on strategic issues.

**Process Used for Identifying Stakeholders and Approach Used to Collect Input From These Groups:** Oregon has approximately 30 statutorily appointed commodity commissions and grower organizations. Most of these have research committees. The membership of these groups provide a rich source of engaged individuals from the natural resources community. Oregon has active environmental, consumer, and community organizations including the Isaac Walton League, Oregon Environmental Council, the Nature Conservancy, Defenders of Wildlife, the Sierra Club, the Food Alliance, Oregon Tilth, and other organizations. The university has a minority Board of Visitors to advise the university and its component colleges on minority affairs. The college also has student governance through the Agricultural Executive Council. This is a very active student council with representatives from over 30 student organizations representing a broad base of students. Included are MANRRS (which hosted the 2002 national MANRRS meeting in Portland with over 900 participants), and the Organic Agriculture Student Association. These groups add breath to more traditional student groups expected in a college of agriculture. These organizations provide a broad perspective for input to the management of the college. An example of how input is used can be found in the "Foundations for the Future" conversation described above. Note the reference to the web page.

**How Input was Considered:** Input is solicited from the various advisory groups on a regular basis and is advisory to the dean and unit leaders of the college in our strategic planning process.

## **C. Program Review Process**

There have been no significant changes in our program review processes since our 5-Year Plan of Work was submitted.

## **D. Evaluation of the Success of Multi and Joint Activities**

The Oregon Agricultural Experiment Station currently has 117 scientists who contribute to 81 multistate projects under the five National Goals. Each multistate projects submit an annual report on their activities, accomplishments and plans for the future. The OAES makes no attempt to evaluate any the multistate research activities as that is accomplished through the efforts of the scientists and administrative advisors in each of those programs. The Western Research Coordination and Implementation Committee is responsible for evaluating each new or revised proposal for projects, and the AES directors approve or disapprove them based on the recommendations from the RCIC.

The Oregon Agricultural Experiment Station contributes to eighty-one multistate projects:

- National Goal #1 (W-006, W-106, W-112, W-128, W-147, W-150, W-168, W-171, W-186, W-192, W-195 W-1133, W-1185, WCC-011, WCC-027, WCC-037, WCC-039, WCC-043, WCC-055, WCC-058, WCC-060, WCC-067, WCC-069, WCC-072, WCC-077, WCC-081, WCC-089, WCC-093, WCC-097, WCC-099, WCC-101, WCC-109, WCC-110, WCC-204, NC-131, NC-1142, NCR-022, NCR-097, NCR-131, NCR-189, NCR-190, NE-124, NE-132, NE-183, NE-1011, NE-1012, NEC-063, S-290, S-1000, S-1004, NRSP-3, and NRSP-6).
- National Goal #2 (W-122, W-150, and WCC-023),
- National Goal #3 (W-122, W-1002, WCC-027, WCC-103, NC-136, and NC-219),
- National Goal #4 (W-045, W-128, W-147, W-150, W-170, W-186, W-187, W-190, W-1133, W-1185, WCC-037, WCC-040, WCC-043, WCC-058, WCC-060, WCC-077, WCC-081, WCC-089, WCC-091, WCC-097, WCC-099, WCC-102, WCC-103, WCC-205, WCC\_temp361, NC-140, NCR-193, NE-103, NE-132, S-285, S-1000, NRSP-3, NRSP-4),
- National Goal #5 (W-128, W-167, W-192, W-194, WCC-055, WCC-058, WCC-207, WCC-208, WCC-1001, NC-223, NC-1119 and NE-1012).

OAES is actively encouraging our scientists to participate in multistate activities. We continue to monitor our progress.

Oregon State University has a unique organizational approach that integrates research, extension and credit education programs. All of the faculty in the statewide branch stations have an academic home in a campus department. They are full members of the department faculty and are fully enfranchised in the departments, colleges and university. For example, extension

faculty stationed in a county hold academic appointment in a department and fully participate in promotion and tenure activities of the department. They hold tenure track and professorial positions. They are fully represented in the Faculty Senate of the university. They plan and implement education (both academic and extension) and research programs in a fully integrated fashion.

Oregon, Idaho, and Washington have a long tradition of cooperation in the region we call “Cascadia.” The region is topologically complex with agri-ecological zones crossing state boundaries and include:

1. The Treasure Valley includes Eastern Oregon and Southern Idaho,
2. The Palouse wheat growing area of Washington extends into Northeastern Oregon and Northern Idaho,
3. The nursery crop and small fruit growing regions of Western Oregon and Washington (Vancouver BC to Eugene, Oregon)
4. The tree fruit growing regions of Hood River/The Dalles, Oregon and Wenatchee, Washington,
5. The hop growing regions of Oregon, Washington and Idaho

Increasingly this concept is being extended to Montana (particularly for potatoes), California (particularly in the Klamath Basin dealing with water management), and the Great Basin states of Utah and Nevada (wildland/rangeland management). This allows improved programming.

The multistate programming is particularly evident in cooperative efforts with the ARS/USDA and includes special projects like STEEP (sustainable dry-land agriculture research and education), the Grass Seed Cropping Systems for Sustainable Agriculture, the Northwest Center for Small Fruits Research, the Northwest Nursery Research Center, the Great Basin Rangeland Management Program.

We also have active initiatives with the Confederated Tribes of the Warm Springs and the Confederated Tribes of the Umatilla. These include a broad array of programs in education and research. These and other tribes participate in undergraduate teaching in the college particularly in developing a multicultural understanding of natural resource management. OSU degree programs in Natural Resources and General Agriculture are available at Warm Springs. The university has a long standing memorandum of understanding and cooperation with the Confederated Tribes of the War Springs that as been mutually beneficial and includes extension, academic teaching and research.

The college operates education programs that focus on Hispanic populations of the region. Hispanics play a major role in the agriculture of the Pacific Northwest. Areas of emphasis have been in the nursery crop and tree fruit crop growing regions of the state.

There are many other examples where there is a long history of planned effort addressing critical issues to the region (Cascadia). Increasingly, these programs are reaching underserved populations with the best examples being the tribes of the region.

## E. Integrated Research and Extension Activities

In 1993 Oregon State University integrated the land-grant functions by:

- elevating *Extended Education* ( now *OSU Statewide*), including the OSU Extension Service (OSUES), to University-wide status;
- integrating OSUES field- and campus-based faculty into academic departments across the University;
- charging academic Deans with leadership responsibility for Extension programs;
- developing P&T guidelines that recognize and reward all three mission areas of the university -- teaching, research, and extension -- through one process;
- defining scholarship to include the integration and application of knowledge as creative intellectual work; and
- creating a unique position description for every OSU faculty member by the joint effort of the faculty member and his/her supervisor and department head.

During 2001 OSUES commissioned a study of the impacts of the above changes on extension programs and faculty. The study revealed that extension faculty, both campus- and field-based, believe there has been significant advances in integration of research, extension, and teaching in terms of the:

- closeness of the working relationship between on- and off-campus faculty,
- degree of integration of research and extension,
- degree to which academic units are implementing extension as part of the fundamental missions,
- degree to which research, instruction, and extension have equal status and importance, and
- extent to which scholarship activities carried out by extension faculty are enhancing extension programs.

Joint appointments in research and extension are the norm in the departments of the College of Agricultural Sciences. Twelve faculty located at research and extension centers and branch research stations have partial or full extension appointments. All multidisciplinary working teams include both extension and research faculty. Many of the Oregon representatives to Regional Research and Coordinating Committees have joint appointments with extension.

The impacts of integrated programs in the western region are highlighted in the “Best of the West” website <http://www.ag.unr.edu/wri/index.html>.

Examples of integrated Research and Extension programs that relate to the IR-4 Pesticide Registration Program for Minor Crops, Integrated Pest Management, Landscape Plant Introduction, and Berry production Systems follow:

- From the public land policy and law educational program, various audiences learn about natural resource policy; range economics, including grazing fees and enterprise budgets; and results of analyses of changes in availability of water, forage, etc., as well as changes in law and policy. The teaching outreach (distance education) component is implemented through websites, videotapes, interactive television, and streaming video.
- Crop profitability analysis (CPA) is a micro-computer program useful to producers of perennial crops, including tree fruit and nuts, berries, Christmas trees, and grapes. CPA helps

them know the best economic point to replace an orchard or vineyard, the costs and benefits of choosing a high-density type planting, and how to incorporate new technologies into current production practices.

- The public policy education program's objectives are (1) to provide policy makers and citizens with information about policy options and consequences to enable them to make informed choices and (2) to help policy analysts and journalists frame issues within a broad public context. Studies include state fiscal issues, state and local tax burdens by income class, impacts of natural resource policy, low-income labor markets, and poverty in Oregon.
- The business management for Oregon dairies program provides education and tools to make wise economic decisions that are interrelated with good stewardship in dairy farming. One important tool is a computer spreadsheet program that allows farmers to compare the costs of farm-grown blended commodities with commercially produced feed.
- The intensive extension campaign to improve irrigation management in Oregon program parallels the research project, guidelines for optimum irrigation management. This program has concentrated on presenting workshops around the state dealing with scientific irrigation scheduling. This year, due to the major shift in irrigation research emphasis from conventional irrigation to optimizing grower net returns, this program is developing new workshop materials to disseminate research findings to growers ready to adopt economically optimal irrigation strategies. Courses to train irrigation advisors and workshops on irrigation management are being held.
- The program, “improved operation and control of fruit storage warehouses,” tests apple and pear storage systems. It provides information on evaporator fan cycling and reducing the number of evaporator fans operating as a means of conserving energy. It also recommends the most effective bin stacking patterns and uses computer simulation of energy use to improve design and management.
- From an experiment and further research, it was determined that a wheat disease, physiological leaf spot (PLS), was not affected at all by fungicide spraying, although such spraying was common because of a misdiagnosis. A subsequent campaign against spraying has practically stopped the practice of spraying for PLS.
- The educational program on diseases of field crops in eastern Oregon provides northcentral and northeastern Oregon growers and their advisors with up-to-date information regarding disease identification, the economic importance of diseases, and disease management options.
- The plant pathology and postharvest extension program provides information about postharvest pathology and horticulture of tree fruit and management of orchard diseases, including research results, regulatory requirements, diagnosis of problems, and new developments in postharvest handling, packaging, and storage of tree fruit.
- As a research-based educational organization, extension provides educational programming for mint growers throughout the state, disseminating information from trials to evaluate varietal susceptibility to verticillium wilt, disease control strategies, fertilizer management efforts, and other research findings.
- The OSU extension weed science program conducts applied research and extension programs in partnership with Oregon growers, the agricultural industry in general, and public agencies. The program bridges the gap between basic research conducted at OSU, as well as nationally and internationally, and practical applications for Oregon's climatic and crop diversity.
- The forage information system on the world-wide-web is a global forage information resource designed to become the premier comprehensive information system for all aspects

of forage production. It links people and information in a work-sharing and access-on-demand environment.

- The cereal variety testing program, a cooperative effort of OSU, the Oregon Wheat Commission, and the Oregon Grains Commission, provides growers and seed dealers in all cereal-growing regions with up-to-date, area-specific performance data on newly released wheat, barley, and triticale varieties so that informed variety selection decisions can be made.
- The potato information exchange is a website with more than 3,500 external links. Information at PIE helps growers improve their bottom line and minimize adverse environmental impacts of production. Alvin Mosley also serves as advisor for websites of the Oregon Seed Potato Growers Association and the Oregon Potato Commission, and as committee chair for the Potato Association of America website.
- Because the potato is asexually propagated, or cloned, diseases and pests are readily passed from generation to generation causing devastating yield losses in many instances and creating demand for high pesticide inputs. The OSU foundation potato seed program breaks this disease cycle by producing and distributing absolutely pathogen-free planting stock to all of Oregon's potato seed growers.
- In 1997, OSU Extension and the Oregon Association of Clean Water Agencies initiated a series of workshops to train managers, wastewater operators, and applicators in appropriate management practices for biosolids (stabilized solids generated by municipal wastewater treatment). Since then, more than 400 participants have been trained.
- As part of the western integrated nutrient management education project, a team of 11 nutrient management specialists from Oregon, Washington, and Idaho are using workshops and educational resources to train agricultural professionals. They, in turn, help agricultural producers to better manage organic nutrient sources, such as manure and commercial fertilizers in their farming operations. Helping producers avoid nutrient losses off the farm is of particular concern.
- The statewide extension grass seed production activity program provides information on disease control, field burning alternatives, weed control strategies, fertilizer management, enterprise budgets, and production guides for Oregon's grass seed growers.
- As OSU works with growers to reduce pesticide loading, this project, in cooperation with DEQ, is monitoring for the three troublesome organophosphate (OP) insecticides. Water samples are being collected from the streams of the Hood River Basin. Preliminary results suggest that the OP levels in 2000 are lower than in 1999, but detections still exceed water quality standards.
- The national pesticide information center provides objective, science-based information on pesticides, e.g., safety practices, clean-up and disposal, regulations; interprets toxicological and environmental chemistry data; accesses resources; explains label information; investigates reported incidents; and aids in emergency treatments.
- The project, "adding value to Oregon whey powder," aims to establish and measure quality parameters of Oregon whey powder and test its incorporation into various food products, such as ice cream. The hope is to facilitate sales of Oregon whey powder as an ingredient in high-priced domestic food products instead of its current, most prevalent use- being shipped out as a commodity to low-priced export markets.
- Applied research and enology extension seek to enhance quality control management practices in the vineyard and the winery that will maintain and improve the quality of Oregon wine. Applied research evaluates the effects of vineyard management practices on fruit



composition and wine quality, while enology extension provides technical assistance to Oregon wineries.

- The berry crops education program disseminates research-based information to the strawberry, blueberry, raspberry, blackberry, and cranberry industries. The program also prepares publications, articles, and presentation materials for the home horticulture audience. A demonstration production trial of hardy kiwi fruit was conducted at NWREC with results published and otherwise disseminated.
- The objectives of a five-year pest management program on pears in southern Oregon are to (1) minimize the negative effects of synthetic pesticides, (2) maximize the positive effects of natural control agents, and (3) maintain acceptable levels of crop productivity and quality.
- The research-extension project, “building a multi-tactic pheromone-based pest management system in western orchards,” builds on the successful codling moth areawide management program that reduced in-season organophosphate use in apples and pears by 75%. Goals are to further reduce broad-spectrum pesticide use, expand the use of mating disruption in pome fruits and new cropping systems, and improve opportunities for biological control of secondary pests in orchards.
- The pear pest management program seeks to (1) reduce synthetic pesticide use in pome-fruit production by training growers in better management methods; (2) encourage the use of available technologies, such as weather information, degree-day models, and other pest control information; (3) identify and map abandoned orchards and rogue pome-fruit trees and educate landowners about pest threats posed for other orchards.
- The information network for small fruits program set up the website, Northwest Berry and Grape Information Network, that offers a comprehensive information and communications resource for researchers, extension educators, processor field representatives, and growers. They can access market reports and production statistics, search databases and libraries, and discuss issues with one another.
- In spring 2000, OSU Extension agents began offering educational meetings to ranchers who have confined-animal feeding operations. In the process, they developed tools that include a white paper, presentations, videotape, and educational display. They are continuing with these educational presentations statewide, as well as into some Washington and Nevada locales.

U.S. Department of Agriculture  
 Cooperative State Research, Education, and Extension Service  
 Supplement to the Annual Report of Accomplishments and Results  
 Multistate Extension Activities and Integrated Activities  
 (Attach Brief Summaries)

Institution: Oregon Agricultural Experiment Station  
 State: Oregon

Check one:  Multistate Extension Activities  
 Integrated Activities (Hatch Act Funds)  
 Integrated Activities (Smith-Lever Act Funds)

**Actual Expenditures**

Title of Planned Program/Activity	USDA Goal	Hatch
An agricultural system that is highly competitive in the global economy	1	\$ 570,293
A safe and secure food and fiber system	2	\$ 62,103
A healthy, well-nourished population	3	\$ 12,946
Greater harmony between agriculture and the environment	4	\$ 162,127
Enhanced economic opportunity and quality of life for Americans	5	\$ 12,464
Total		\$ 819,933

*Thayne R. Johnson* 5/21/03  
 Director Date